GENOME RELATIONSHIPS
IN THE
ONCIDIUM ALLIANCE

A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL OF
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INTRODUCTION

The *Oncidium* alliance of the subtribe Oncidiinae Bentham forms one of the largest alliances in the family Orchidaceae. It comprises over 1,000 species with diverse habit and floral structures. The classification of the orchids in this alliance into species, sections, and genera based on similarities and differences in floral morphology appears to be inadequate and some of the taxa may not merit recognition.

A wide range of species in several genera of the alliance are popular among orchidists because of their horticultural value. Numerous interspecific and intergeneric hybrids have been made by orchid breeders, and recently the results of hybridization have been applied as one of the criteria for grouping of species, sections and genera.

The information on chromosome numbers and morphology has been of value in classification, phylogeny, and breeding of orchids and studies involving meiotic chromosome pairing in species hybrids have provided additional information on species relationships in orchids.

The present study included hybridization of available species in the *Oncidium* alliance, mainly *Oncidium* spp., to determine self and cross compatibilies, the establishment of chromosome numbers of species and hybrids, analyses of karyotypes of several species with relatively low chromosome numbers and observations of meiotic behavior of some interspecific hybrids. The information obtained is intended to elucidate species relationships and to aid breeding programs in this plant group.

REVIEW OF LITERATURE

The subtribe Oncidiinae comprises a large number of pseudobulbous American epiphytes (Bentham, 1881). The rhizomes give rise to stems which usually terminate in pseudobulbs of a single internode on top of which are one or two leaves. A few distichous leaves or leaf sheaths are present at the base of the pseudobulb, in the axils of which are the leafless peduncles or scapes. The pseudobulb is sometimes almost sessile on the rhizome, and in some genera the pseudobulb is very small or absent in which case the leaves are distichously imbricate on the rhizome. The column is footless, forming no real mentum, but in a few genera the labellum or the lateral sepals or both together form a spur at their base. The pollinium has a well developed stipe.

Pfitzer (1889) elevated Bentham's subtribe Oncidiinae to a tribe and divided it into five subtribes. Schlecter (1926) further subdivided this group into eleven subtribes. Dressler and Dodson (1960) in their review of the Orchidaceae united Schlecter's subtribes into the subtribe Oncidiinae Bentham. However, Dressler and Dodson recognized three distinct groups or alliances within the subtribe.

The _Oncidium_ alliance is separated from the rest of the subtribe Oncidiinae on the basis of the difference in the number of pollinia. The species in the _Oncidium_ alliance have only two pollinia in contrast to the species in the other alliances of the same subtribe which have four pollinia.

The _Oncidium_ alliance comprises forty-eight closely related genera: _Ada_, _Amparoa_, _Aspasia_, _Brachtia_, _Brassia_, _Capanemia_, _Caucaea_, _Chaenanthe_, _Cochlioda_, _Comparettia_, _Diadenium_, _Erycina_, _Gomesa_, _Hybochilus_, _Ionopsis_, Leochilus, Lockhartia, Macradenia, Mesospinidium, Miltonia, Neodryas, Neokoehleria, Notylia, Odontoglossum, Oncidium, Papperitzia, Petalocentrum, Polytidium, Plectrophora, Pterostemma, Quekettia, Rodriguezia, Rodrigueziopsis, Roezliella, Rusbyella, Sanderella, Saundersis, Scelochilus, Sigmatostalix, Solenidium, Systeloglossum, Sutrina, Theodorea, Trichocentrum, Trichopilia, Trizeuxis, and Warmingia (Dressler and Dodson, 1960). Williams (1970) estimated this group of orchid to consist of 900-1,100 species. All species in the alliance are native of tropical and subtropical America, being widely distributed from Florida and Mexico through the West Indies and Central America to Argentina. The species exhibit diverse vegetative and floral structures. They are epiphytic, terrestrial, or lithophytic plants inhabiting hot sea-level to cool mountainous areas (Correll, 1950; Hawkes, 1965; Schultes, 1960).

Oncidium, the largest genus of the group, attracted the attention of several orchid taxonomists. Lindley (1855) divided the genus into fourteen sections. Bentham (1881) accepted only three of Lindley's sections and tentatively put all the rest of the species into the section Planifolia. Pfitzer (1889), however, maintained most of Lindley's sections and distributed the species into sixteen sections. Kranzlin (1922) classified Oncidium into eighteen sections in his monograph of the genus, while Garay (1970) proposed a reappraisal of the genus and incorporated the genus Cyrtochilum and some species of Odontoglossum into the twenty-five sections including all existing type specimens and species described since 1922.

Odontoglossum the second largest genus was divided by Lindley (1952) into six sections, of which only one was considered natural by Bentham (1881). Pfitzer (1889) separated the genus into eight sections.

Dodson (1958) noted that the species in the *Oncidium* alliance were botanically difficult to separate and that precise generic descriptions were difficult to compile. Garay (1963) suggested that a large number of genera in the alliance are wholly artificial and they might have to be united with *Oncidium*.

The first chromosome count of *Oncidium* was made by Afzelius in 1916. Since then several published accounts on *Oncidium* and its allied genera have appeared (Hoffmann, 1929, 1930; Eftimiu-Heim, 1941; Dodson, 1957a, 1957b, 1957c, 1958; Blumenschein, 1960; Sagawa and Niimoto, 1961; Sinoto, 1962; Chardard, 1963; Garay, 1963; Kugust, 1966; Sharma and Chatterji, 1966; Charanasri, Kamemoto and Takeshita, 1973). Chromosome counts have been recorded to date for eighty-six species in *Oncidium* and fifty-three species in allied genera. The chromosome numbers reported are 2n = 10, 14, 24, 26, 28, 30, 32, 34, 36, 37, 40, 42, 44, 46, 48, 50, 54, 56, 60, 72, 84, 112, 133, and 168.

The karyotypes of six species of *Oncidium*, one species of *Brassia* and one *Brassidium* hybrid (an intergeneric hybrid) were analyzed by Sinoto (1962, 1964, 1966, 1969), and Dodson (1958) discussed the cytotaxonomy in *Oncidium* and a few of its allied genera based on the morphology of nuclei at the interphase stage, chromosome numbers, chromosome morphology, and cell size.

Grant (1971) classified orchids into perennial herbs with an outcrossing breeding system, having specialized flowers. Species are intercompatible, interfertile and chromosomally homologous within a wide range. Species are isolated primarily by mechanical and ethological factor, and secondarily by other external factors.

Numerous man-made hybrids in the Oncidium alliance have appeared since 1909 (Sanders, 1946; Sanders and Wreford, 1961; the Royal Horticulture Society, 1972; the Orchid Review, 1971-1973). Moir (1959) recorded a large number of bigeneric hybrids involving genera in the subtribe Oncidiinae and many other closely related subtribes of Schlecter's (1926) classification and suggested that these subtribes be integrated. Moir (1964, 1966, 1967, 1973) published additional accounts on the results of his intergeneric hybridization within the Oncidium alliance. The various intergeneric crosses made to date give an indication of the interrelationships of numerous genera.

Darwin (1897) found that some species of Oncidium and its related genera are self-incompatible. Sanford (1964) studied the sexual compatibility relationships in the Oncidium alliance analyzing all registered hybrids of the genus Oncidium including its intergeneric crosses, and grouped the species on the basis of their crossability and the fertility of the hybrids. Fifty-eight species of Oncidium were arranged in four groups according to their cross-compatibility relationships, and six closely related genera were also grouped according to their cross-compatibility with the four established groups of Oncidium. Sanford (1967) published further studies involving sixty-seven new crosses. Ten species used in the crosses were placed in the four groups previously reported.

In the past decade some new procedures applicable to the hybridization of orchids have been introduced. Meeyot and Kamemoto (1969) found that pollinia of Oncidium stipitatum stored at $7^{\circ}C$ retained their viability for a year, hence the possibility exists in making crosses between species with different flowering seasons. Sagawa and Valmayor (1966) were successful in performing embryo culture of three Oncidium species and one hybrid and recommended this technique for saving the immature embryos from abortion.

In many groups of plants chromosome pairing in the F_1 hybrids is a good indication of the degree of relationship between the two parents (Stebbins, 1971). According to Clausen (1951), the lack of chromosome homology represents a major stage in evolutionary differentiation. In the Orchidaceae, studies involving meiotic chromosome pairing in species hybrids have provided some clarification on chromosome homology and species relationships in the subtribe Sarcanthinae (Kamemoto, 1963), and a portion of the genus Dendrobium (Shindo and Kamemoto, 1963; Kamemoto, Shindo, and Kosaki, 1964).

MATERIALS AND METHODS

The species and hybrids of the *Oncidium* alliance used in this investigation were available in the Horticulture Department of the University of Hawaii. The available species are listed in Table I. Most of them were obtained from orchid growers in Hawaii and other parts of the United States.

Somatic chromosome number determinations and karyotype studies were made utilizing vigorously growing root tips. Samples were cut approximately two mm long between the hours of 9:00 and 12:00 noon. These were pretreated in 0.002 M 8-hydroxyquinoline for four hours at 15°C and fixed in 1:1:2 mixture of 95% ethyl alcohol, chloroform, and glacial acetic acid for 20 minutes at 10°C. When immediate squashing was not possible the root tips were stored at 7°C in 45% acetic acid for up to a week.

In preparation for squashing, the root tip was hydrolyzed with 1 N hydrochloric acid for seven minutes at 50°C. It was immediately washed with tap water, and kept in 45% acetic acid for ten minutes. After removing the root cap the remaining tissue was cut into small pieces with dissecting needles under a dissecting microscope. A drop of 1% aceto-orcein was added onto the tissue. The slide was then placed for ten minutes in a glass chamber saturated with acetic acid vapor. The slide was removed from the chamber, and a cover glass was added. Air bubbles and excess stain were removed by applying pressure on the cover slip after the slide was heated gently. The cover slip was sealed with sticky dental wax.

The preparations were examined under a microscope and chromosome

TABLE I

LIST OF SPECIES UTILIZED IN THIS STUDY

Taxa
Genus *Ada* Lindl.
A. elegentula (Rchb. f.) N. H. Williams
A. sp.
Genus *Aspasia* Lindl.
A. epidendroides Lindl.
A. principissa Rchb. f.
Genus *Brassia* R. Br.
Sect. *Glumaceae* Lindl.
B. allenii L.O. Williams
Sect. *Brassia*
B. caudata (L.) Lindl.
B. gireoudiana Rchb. f. & Warsc.
Genus *Comparettia* Poepp. & Endl.
C. falcata Poepp. & Endl.
Genus *Gomesa* R. Br.
G. crispa (Lindl.) Klotzoch & Rchb. f.
G. recurva (Lindl.) R. Br.
Genus *Lockhartia* Hook.
L. micrantha Rchb. f.
Genus *Miltonia* Lindl.
Sect. *Eumiltonia* Pfitz.
M. flavescens Lindl.
M. spectabilis Lindl.
Sect. *Miltoniopsis* Pfitz.
M. roezlii (Rchb. f.) Nichols.
Genus *Odontoglossum* H.B.K.
Sect. *Grandia* Pfitz.
O. grande Lindl.
Sect. *Laevia* Pfitz.
O. stenoglossum (Schltr.) L.O. Williams
Sect. *Trymenium* Lindl.
O. citrosmum Lindl.
Sect. *Xanthoglossum* Lindl.
O. cariniferum Rchb. f.
Genus *Oncidium* Sw.
Sect. *Altissima* Kzl.
O. altissima Sw.
Genus *Oncidium* (continued)
Sect. *Altissima* (continued)
O. ansiferum Rchb. f.
O. baueri Lindl.
O. ensatum Lindl.
O. floridanum Ames
O. wenworthianum Batem. ex Lindl.
Sect. Barbata Lindl. ex Pfitz.
O. micropogon Rchb. f.
Sect. *Concoloria* Kzl.
O. concolor Hook.
O. onustum Lindl.
Sect. *Crispa* Rchb. f.
O. marshallianum Rchb. f.
O. sarcodes Lindl.
Sect. *Equitantia* Lindl.
O. x ann-hadderiae Moir
O. bahamense Nash ex Britt. & Millsp.
O. calochilum Cogn.
O. x cubense Moir
O. desertorum Nash ex Withner
O. x floride-phillepsiae Moir & Hawkes
O. henekenii Schomb. ex Lindl.
O. jimenezii Moir
O. leiboldii Rchb. f.
O. lemonianum Lindl.
O. lucayanum Nash ex Britt. & Millsp.
O. pulchellum Hook.
O. quadrilobum C. Schweinf.
O. scandens Moir.
O. sylvestre Lindl.
O. tetrapetalum (Jacq.) Willd.
O. triquetrum (Sw.) R. Br.
O. urophyllum Lodd. ex Lindl.
O. variegatum (Sw.) Sw.
O. x varvelum Moir
O. velutinum Lindl.

TABLE I. (Continued) LIST OF SPECIES UTILIZED IN THIS STUDY

Taxa	Taxa
Genus *Oncidium* (continued)	Genus *Oncidium* (continued)
Sect. *Glanduligera* Lindl.	Sect. *Teretifolia* Lindl.
O. liminghei Morren	*O. cebolleta* (Jacq.) Sw.
O. papilio Lindl.	*O. jonesianum* Rchb. f.
Sect. *Miltoniastrum* Rchb. f.	*O. nudum* Batem
O. bicallosum Lindl.	*O. stipitatum* Lindl.
O. carthagenense (Jacq.) Sw.	Sect. *Tigrina* Kzl.
O. lanceanum Lindl.	*O. tigrinum* Llav & Lex
O. luridum Lindl.	Sect. Unclassified
O. microchilum Batem. ex Lindl.	*O. ampliatum* Lindl.
O. splendidum A. Rich.	Genus *Ornithophora* Rodr.
O. stramineum Lindl.	*O. radicans* (Rchb. f.) Garay & Pabst
Sect. *Oblongata* Kzl.	Genus *Rodriguezia* Ruiz & Pavon
O. isthmi Schltr.	*R. secunda* H.B.K.
O. oblongatum Lindl.	*R. venusta* (Lindl.) Rchb. f.
Sect. *Pulvinata* Lindl.	Genus *Trichocentrum* Poepp & Endl.
O. pulvinatum Lindl.	*T. albo-purpureum* Rchb. f. ex Rodr.
Sect. *Serpentia* (Kzl.) Garay 1970	*T. capistratum* Rchb. f.
O. globuliferum H.B.K.	Genus *Trichopilia* Lindl.
Sect. *Stellata* Kzl.	*T. marginata* Henfr.
O. leucochilum Batem	
O. maculatum (Lindl.) Lindl.	
O. migratum Lindl.	
Sect. *Synsepala* Pfitz.	
O. flexuosum Sims.	

numbers were determined. Photomicrographs of selected mitotic metaphase stage were taken at a magnification of 550 X on Kodak High Contrast Copy film.

For karyotype analysis, the negatives were projected with a photographic enlarger to give a magnification of 5,500 X. The chromosomes were traced on a piece of white paper. The length of each chromosome and the centromeric position were determined. The chromosomes were arranged in a descending order of the total length. The unit of measurement was 0.5 mm.

The chromosome lengths were expressed as the mean length of each complement. The centromeric position of a chromosome was expressed as the F%, which is the percentage of the short arm length over the total length of a chromosome. The symmetry of the karyptype morphology was determined from the mean F% of the chromosome complement. The chromosomes were grouped into three classes according to their centrometic positions, using the F% values: 0-30.0 (subterminal); 30.1-40.0 (submedian); 40.1-50.0 (median).

Meiotic studies were made utilizing the pollinia of young flower buds. A portion of the pollinium was taken from the bud and placed on a drop of 45% acetic acid on a microslide. After removing all extraneous materials, a drop of 1% aceto-orcein was added to the PMCs. A cover slip was placed over them and the sample was examined under a microscope to determine the stage of meiotic cell division. If metaphase I was observed the remaining pollinia in the bud were fixed in 45% acetic acid for ten minutes at 10°C. Staining and squashing of the fixed PMCs were the same as described for somatic chromosome studies. If the meiotic stage was too early the flower bud was carefully sealed and subsequently sampled periodically to obtain the PMCs at metaphase I. The same technique was employed to obtain the proper stage of microspore division. The pairing of chromosomes at metaphase I and the type of sporad groups formed were analyzed. Photomicrographs of the selected meiotic stages and sporad groups were taken.

Self-pollinations and intraspecific, interspecific, and intergeneric crosses were made using species in flower in the University collection. When flowers were abundant all possible cross combinations and their reciprocals were made. Excess pollinia of some species were collected, packed into capsules and placed in 150 ml sealed bottles and stored at 7°C. Stored pollinia were used up to twelve months from the time of collection in order to perform crosses involving individuals with different flowering seasons.

The date of pollination, the period from pollination to abscission if the ovary did not develop or was partially developed, and the date of harvest of the fruit were recorded.

Due to variations in fruit development, fruits were harvested from one and a half to four months after pollination depending on the maternal parents. This period is ample for fertilization and embryo development to occur in the _Oncidium_ alliance (Sagawa and Valmayor, 1966). The seeds were germinated in 125 ml Erlenmeyer flasks containing 25 ml of a modified Vacin and Went medium. About three months after seed germination, approximately 75 seedlings were transplanted from the mother flask into a 500 ml Erlenmeyer flask containing about 80 ml of the same medium. From six to eight months after transplanting, the seedlings were removed and planted in community pots. With further growth they were repotted into individual pots and grown to flowering.

The percentage of developed embryos was determined by examining a small amount of seed. The seeds were spread on a microslide and a drop of 1% aceto-orcein was added. A cover slip was placed and the percentage of nonaborted embryos was determined from a sample of 100 seeds from each fruit harvested.

To determine the fertility of the species hybrids that flowered, siblings or individuals from the same cross combinations were crossed. A number of species hybrids were also self-pollinated. Some hybrids were backcrossed to one or both parental species. The percent fruit set and percent apparently viable seed from each fruit harvested were recorded for the compatible matings.

Color slides and black-and-white photographs were taken of most species and hybrids in flower and placed on file in the Department of Horticulture. Detailed drawings of plants and individual flowers of selected species and hybrids were made for illustration in this text (Figures 1-19). Dried and pressed specimens were made of plants investigated when in flower and deposited in the herbarium of the Botany Department, University of Hawaii.

Plate I

Figure 1. Brassia caudata (L.) Lindl. A -- flower, 1X; B -- labellum, 3X

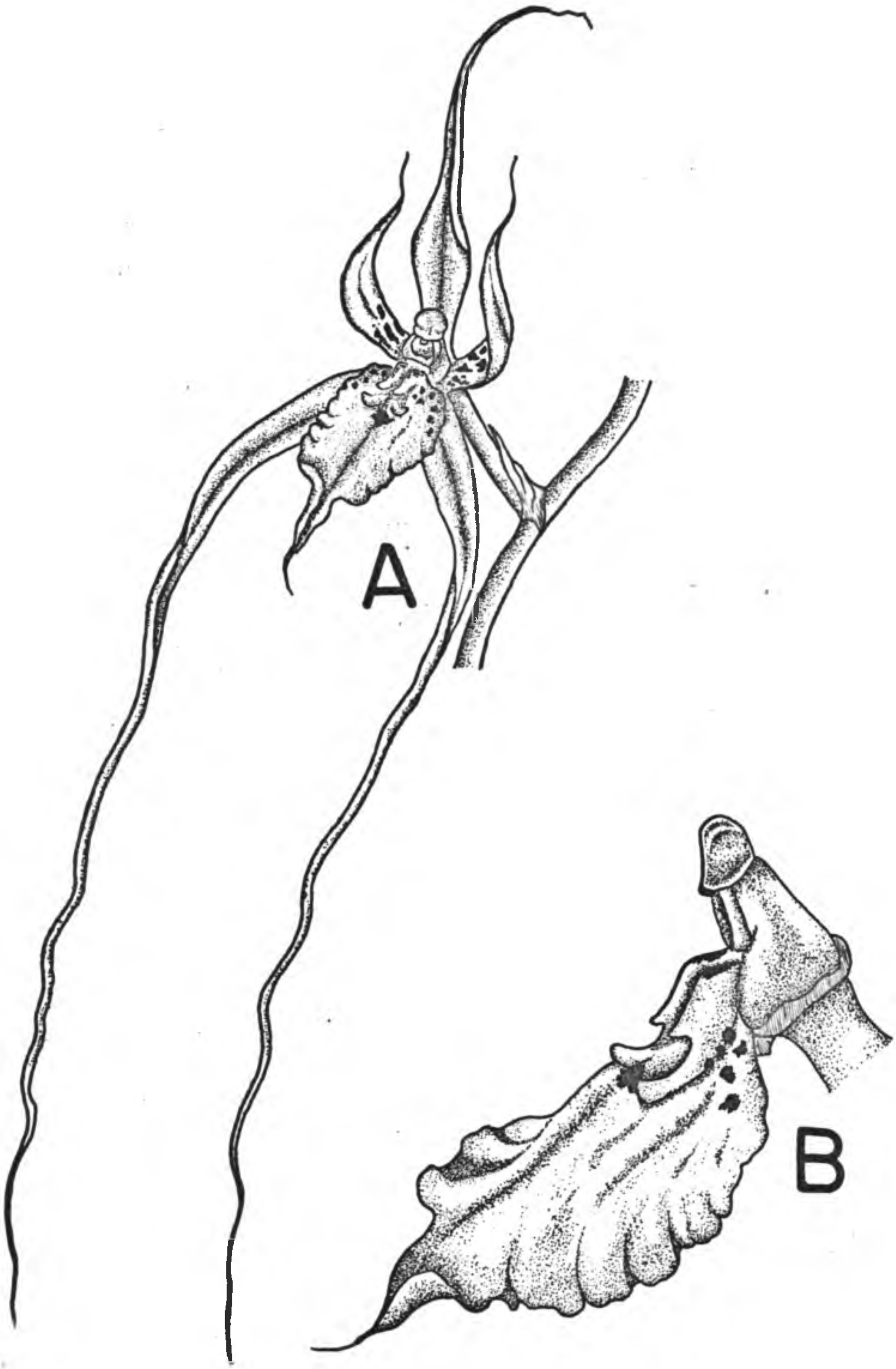

A
B

Plate II

Figure 2. Oncidium floridanum Ames A -- flower, front view, 3X; B -- flower, rear view, 2X; C -- crest, 10X

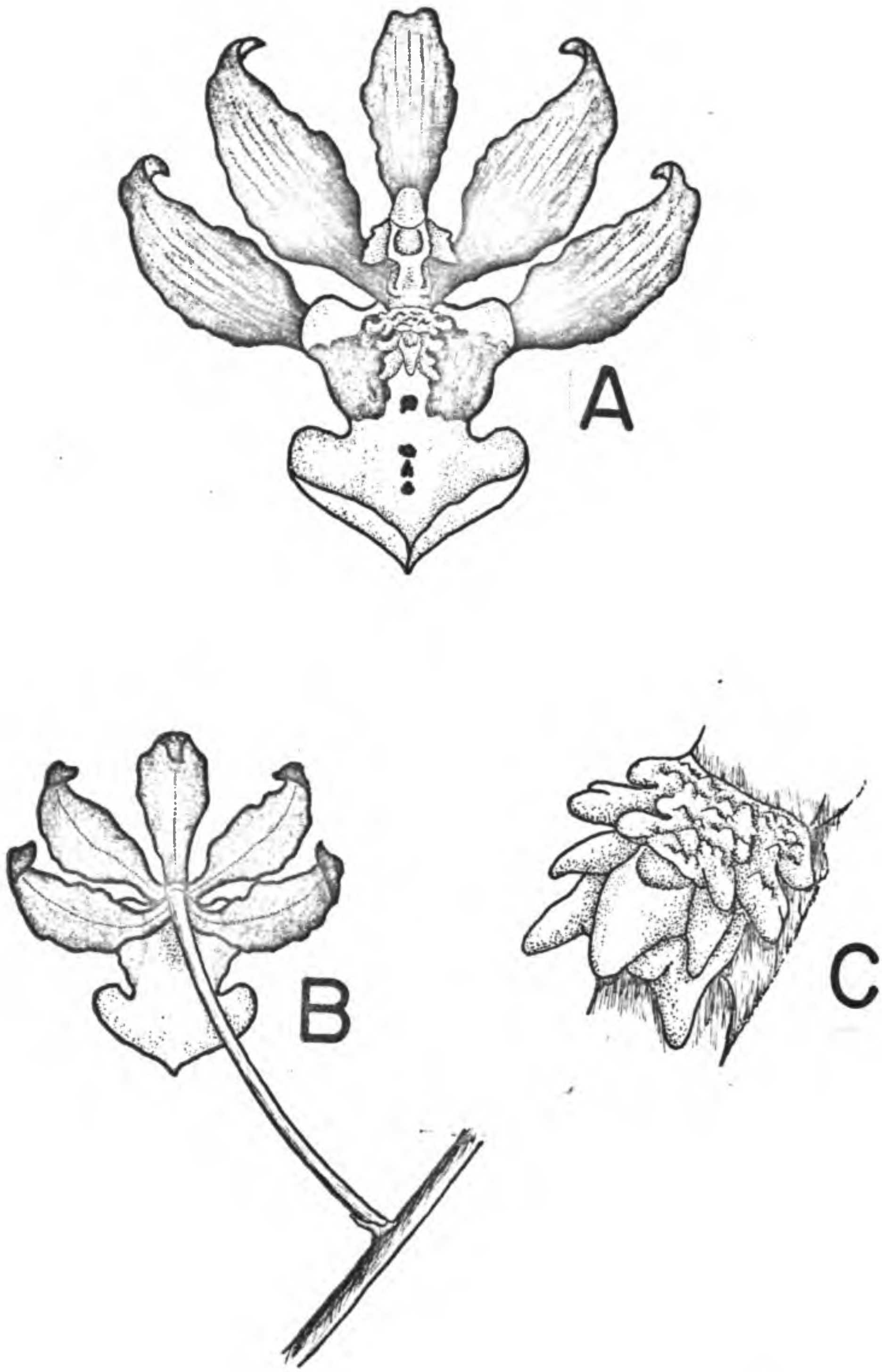
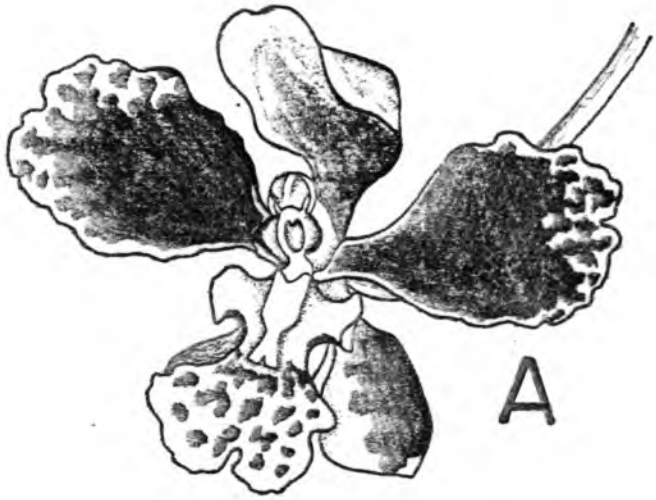
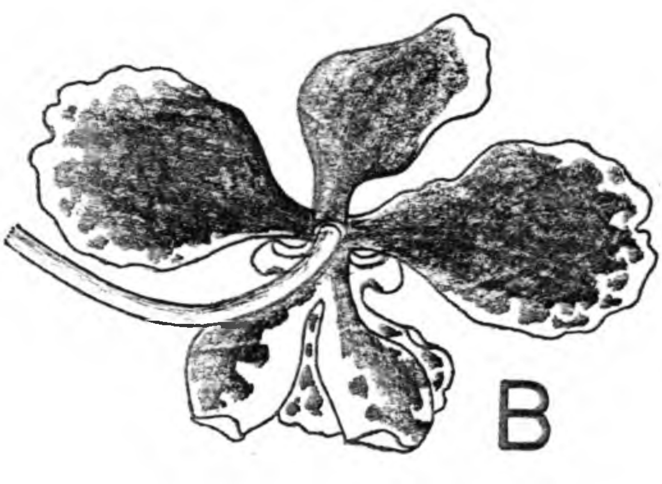

A
B
C

Plate III

Figure 3. *Oncidium sarcodes* Lindl. A -- flower, front view, 2X; B -- flower, rear view, 2X



A



B

Plate IV

Figure 4. Oncidium onustum Lindl. A -- flower, front view, 3X; B -- flower, rear view, 2X; C -- crest, 10X

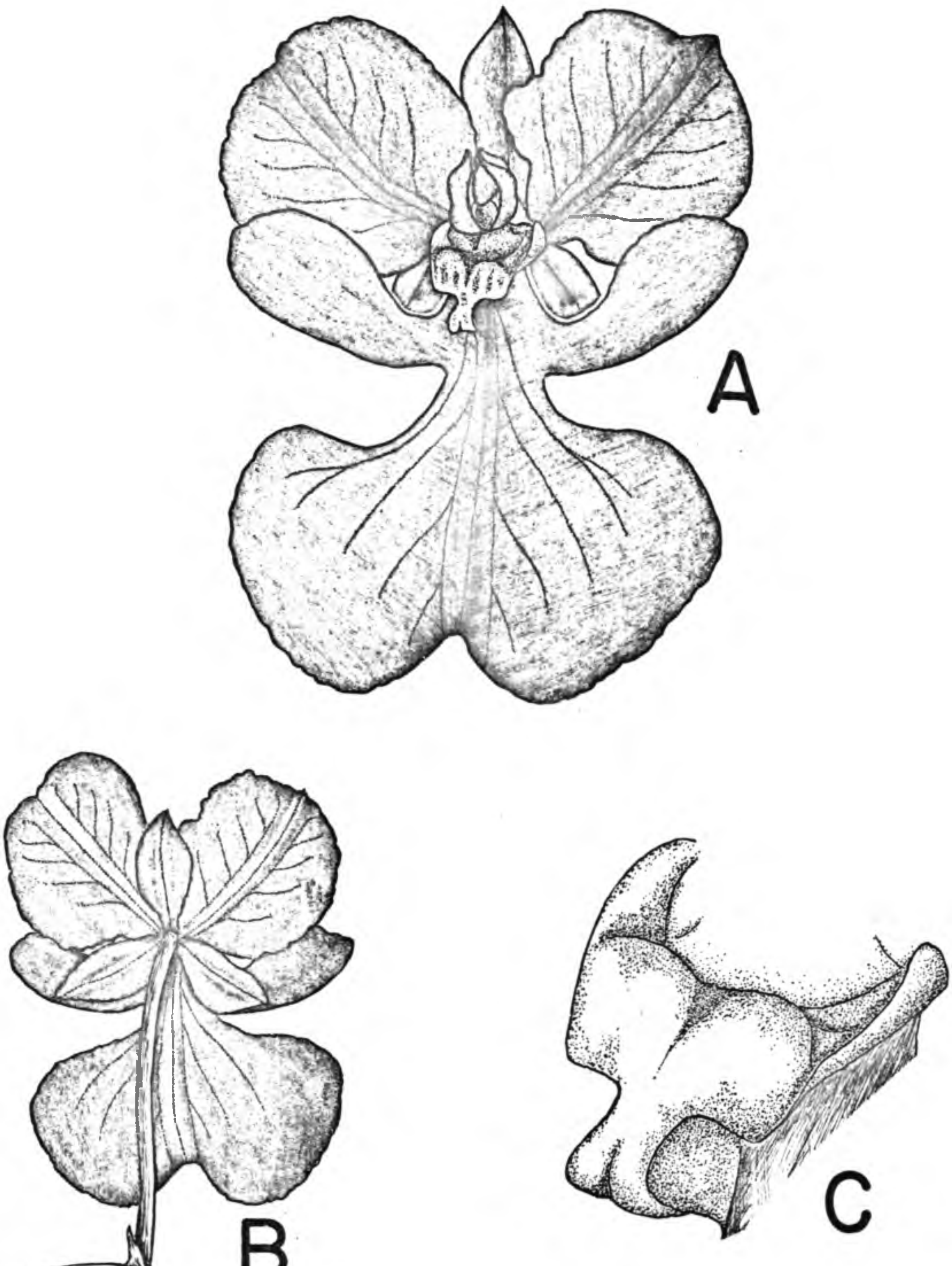

A
B
C

Plate V

Figure 5. Oncidium variegatum (Sw.) Sw. A -- flower, front view, 3X; B -- flower, rear view, 3X; C -- crest, 10X

A

B

C

Plate VI

Figure 6. Oncidium luridum Lindl. A -- flower, front view, 2X; B -- flower, rear view, 2X; C -- crest, 7X

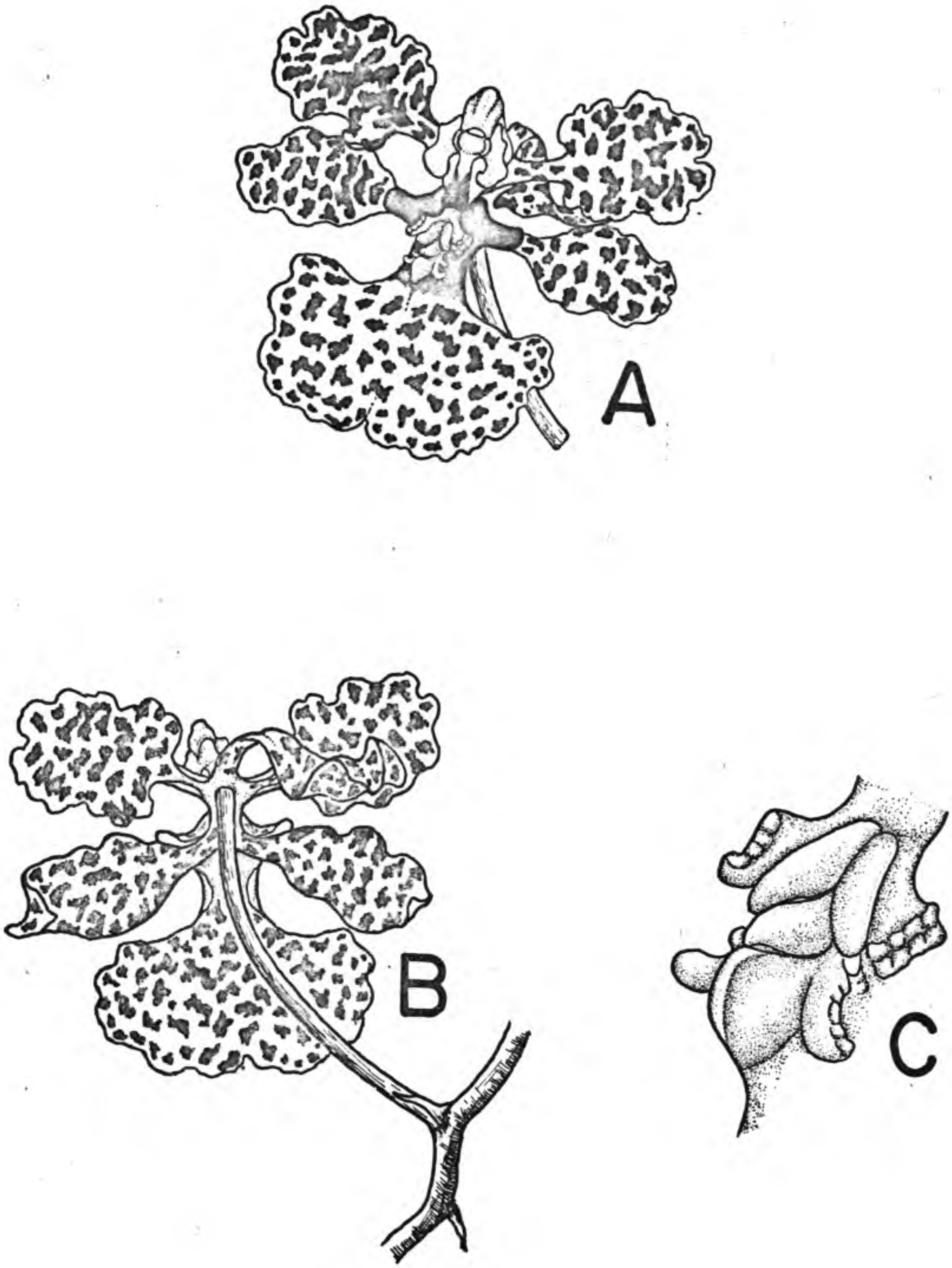
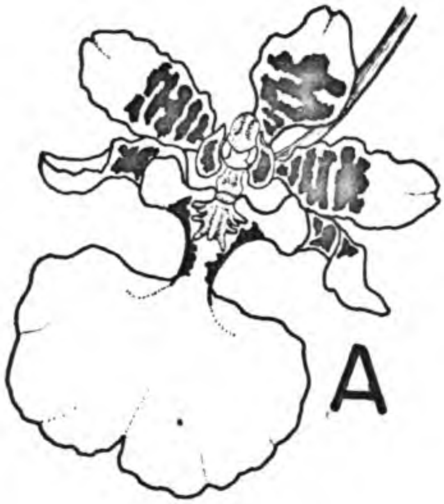

A
B
C

Plate VII

Figure 7. Oncidium isthmi Schltr. A -- flower, front view, 2X;
B -- flower, rear view, 1X; C -- crest, 8X



A

B

C

Plate VIII

Figure 8. Oncidium leucochilum Batem. A -- flower, front view, 3X; B -- flower, rear view, 2X; C -- crest, 10X

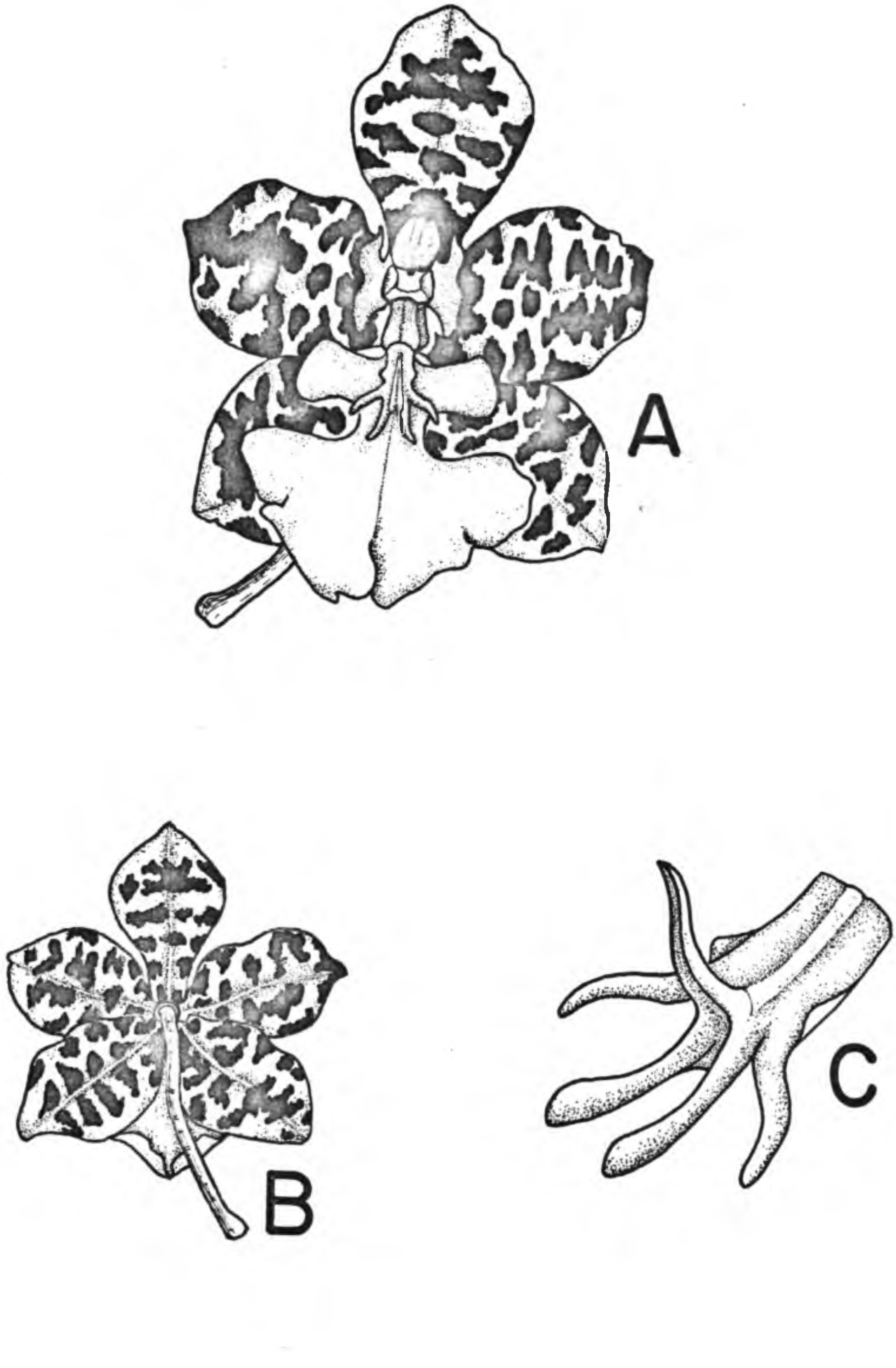

A
B
C

Plate IX

Figure 9. Oncidium flexuosum Sims. A -- flower, front view, 3X; B -- flower, rear view, 2X; C -- crest, 10X

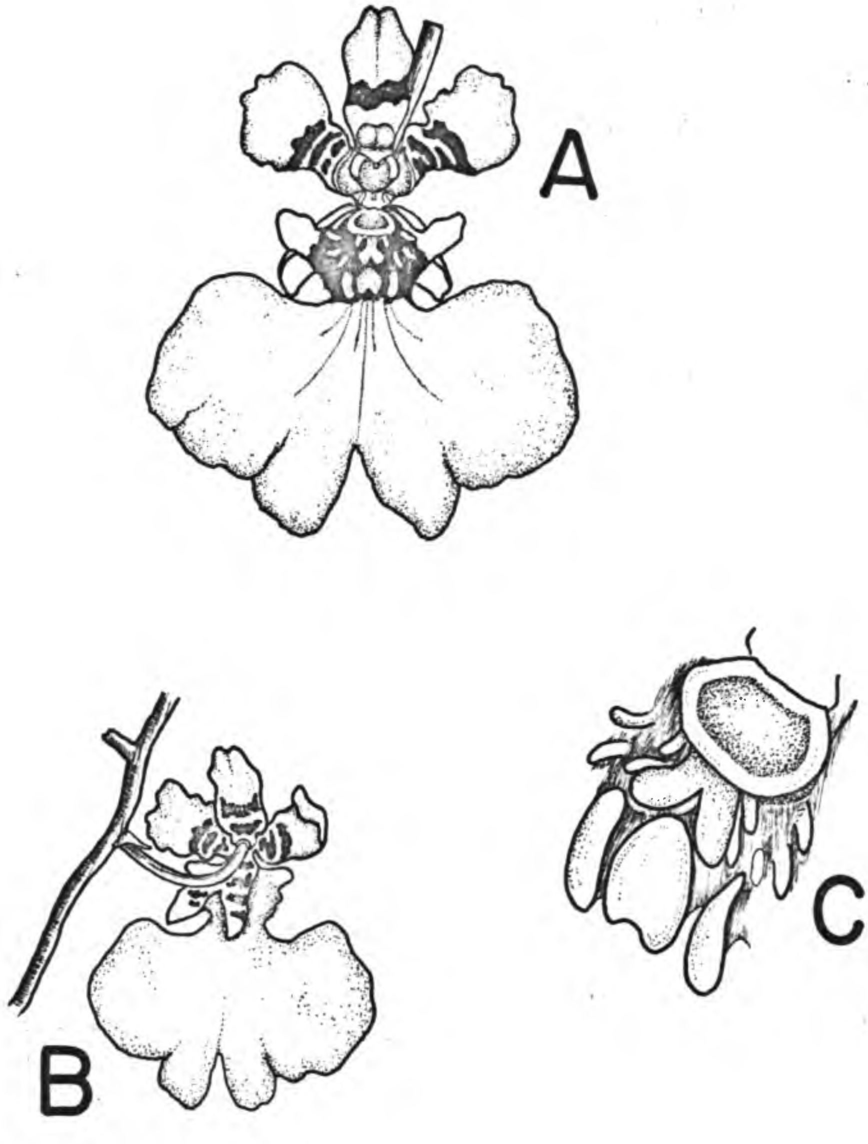

A
B
C

Plate X

Figure 10. Oncidium stipitatum Lindl. A -- flower, front view, 3X; B -- flower, rear view, 3X; C -- crest, 10X

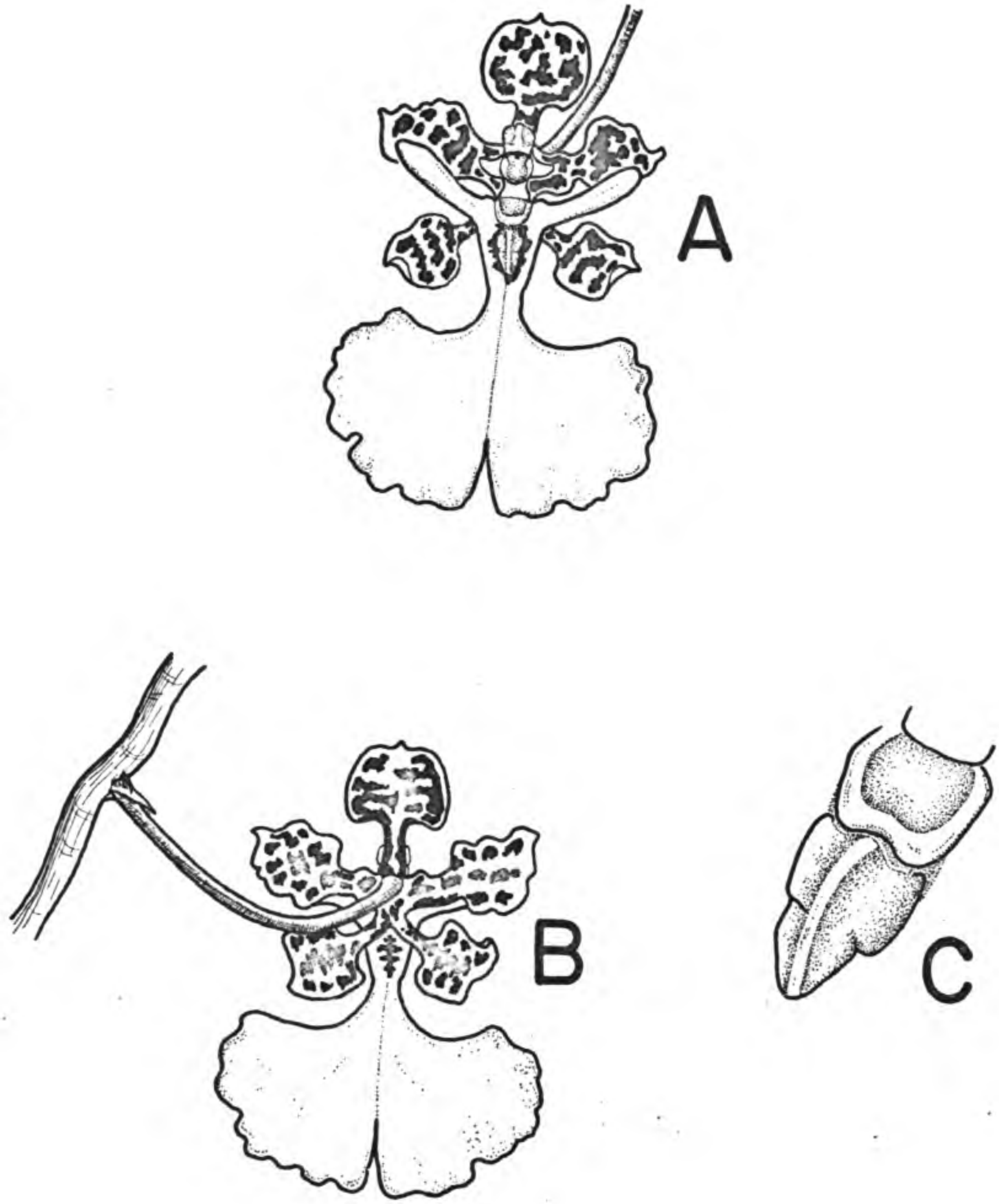

A
B
C

Plate XI

Figure 11. Oncidium ampliatum Lindl. A -- flower, front view, 2X;
B -- flower, rear view, 1X; C -- crest, 10X

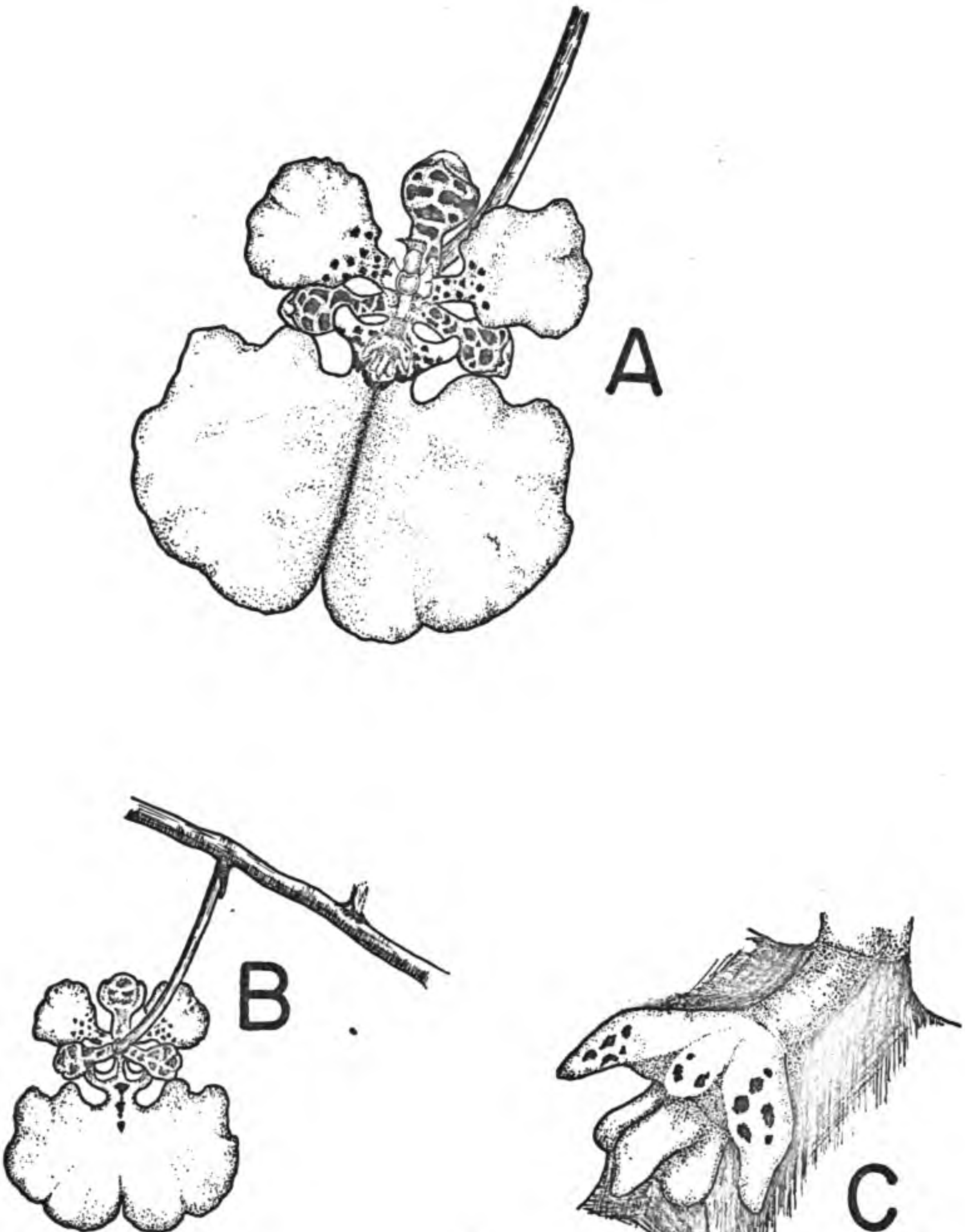
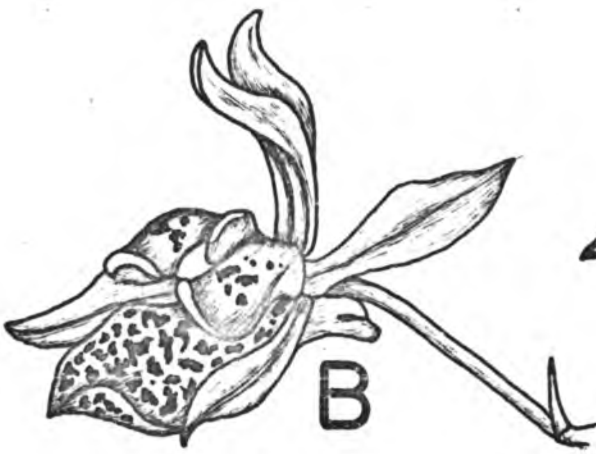

A
B
C

Plate XII

Figure 12. Trichocentrum capistratum Rchb. F. A -- front view, 3X; B -- flower, side view, 3X; C -- plant, 1X


A


B

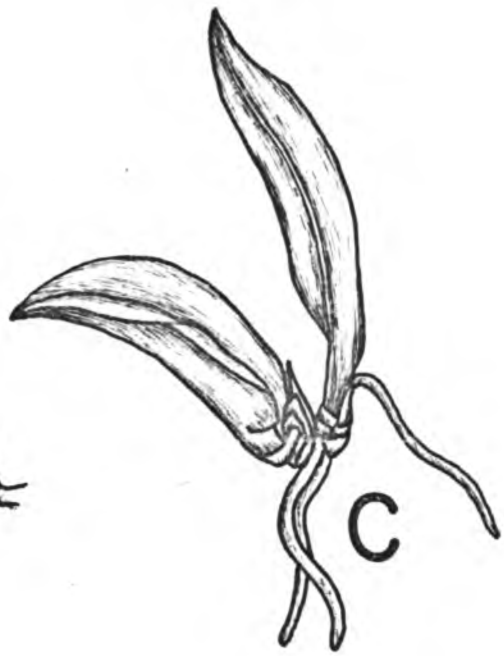

C

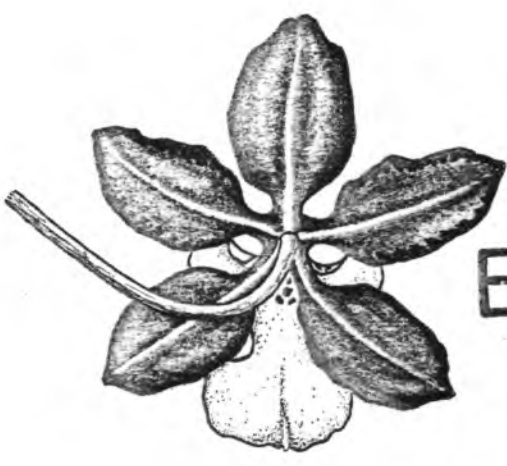
Plate XIII

Figure 13. Oncidium microchilum Batem. ex Lindl. x O. floridanum Ames

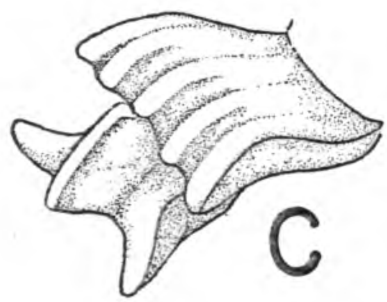
A -- flower, front view, 2X; B -- flower, rear view, 2X;

C -- crest, 10X

A



B



C

Plate XIV

Figure 14. Oncidium maculatum (Lindl.) Lindl. x Rodriguezia venusta (Lindl) Rchb. f. A -- flower, front view, 3X; B -- flower, side view, 2X; C -- column, front view 5X; D -- synsepalum, 2X

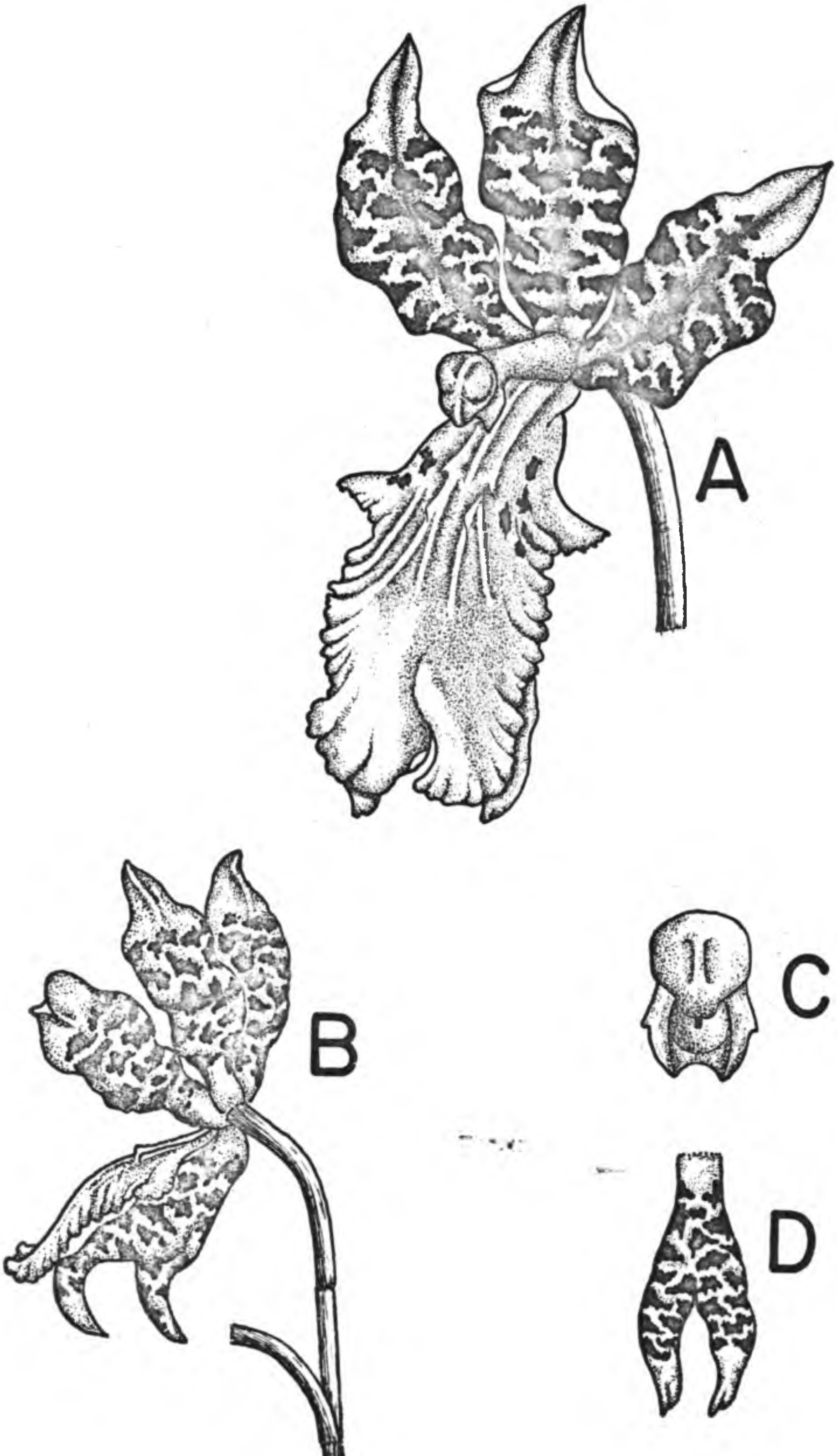

A
B
C
D

Plate XV

Figure 15. Vegetative morphology of Oncidium species and their hybrid. A -- O. microchilum, plant, 1/2 X; B -- O. carthagenense, plant, 1/4 X; C -- O. carthagenense, pseudobulb, 1/2 X; D -- O. microchilum x O. carthagenense, plant, 1/4 X; E -- O. microchilum x O. carthagenense, pseudobulb, 1/2 X

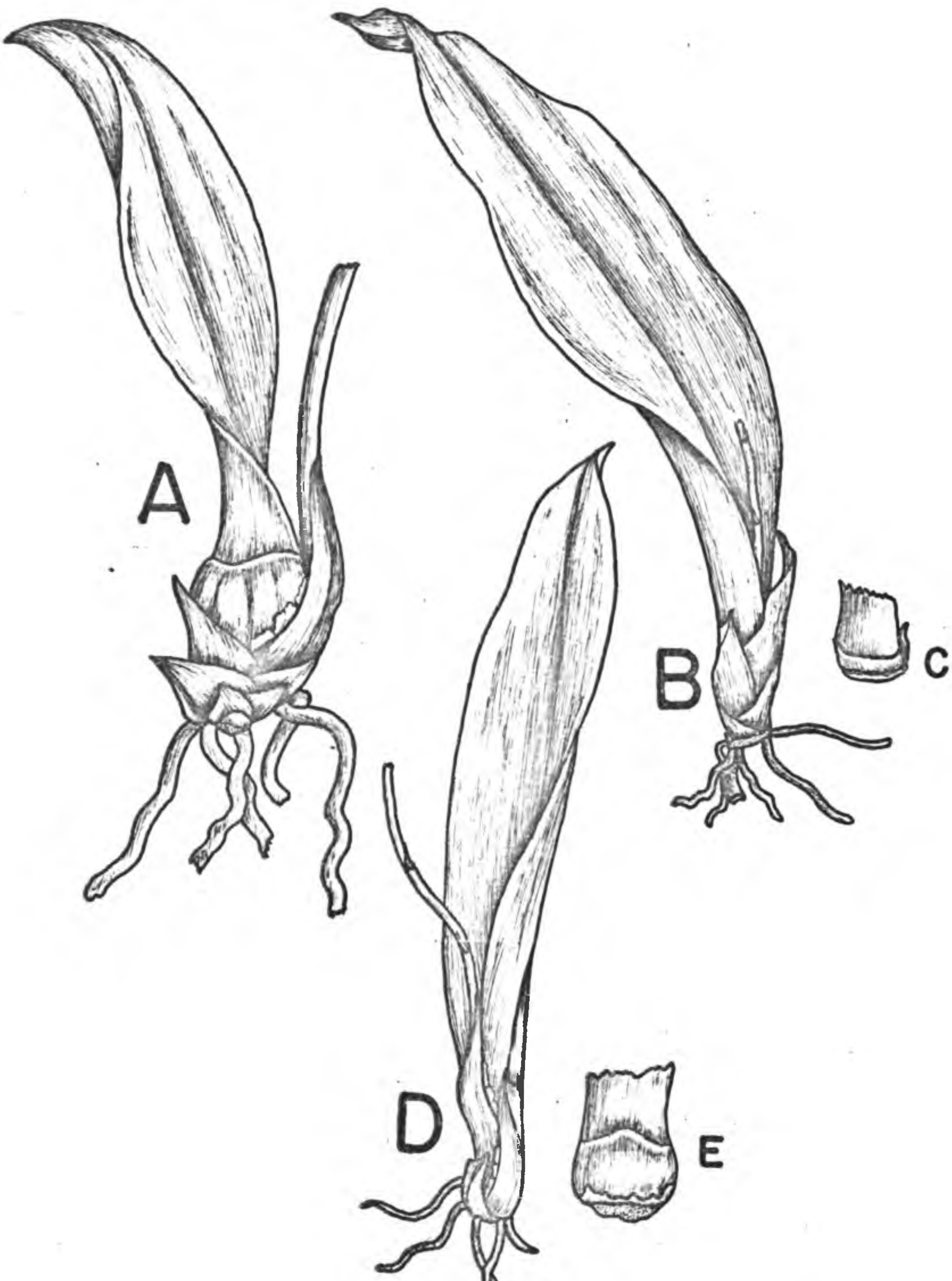

A
B
C
D
E

Plate XVI

Figure 16. Vegetative morphology of *Oncidium* species and their hybrid.

A -- *O. floridanum*, plant, 1/8 X; B -- *O. triquetrum*, plant, 3/8 X; C -- *O. triquetrum*, pseudobulb, 3/4 X;

D -- *O. triquetrum* x *O. floridanum*, plant, 3/8 X;

E -- *O. triquetrum* x *O. floridanum*, pseudobulb, 3/4 X.

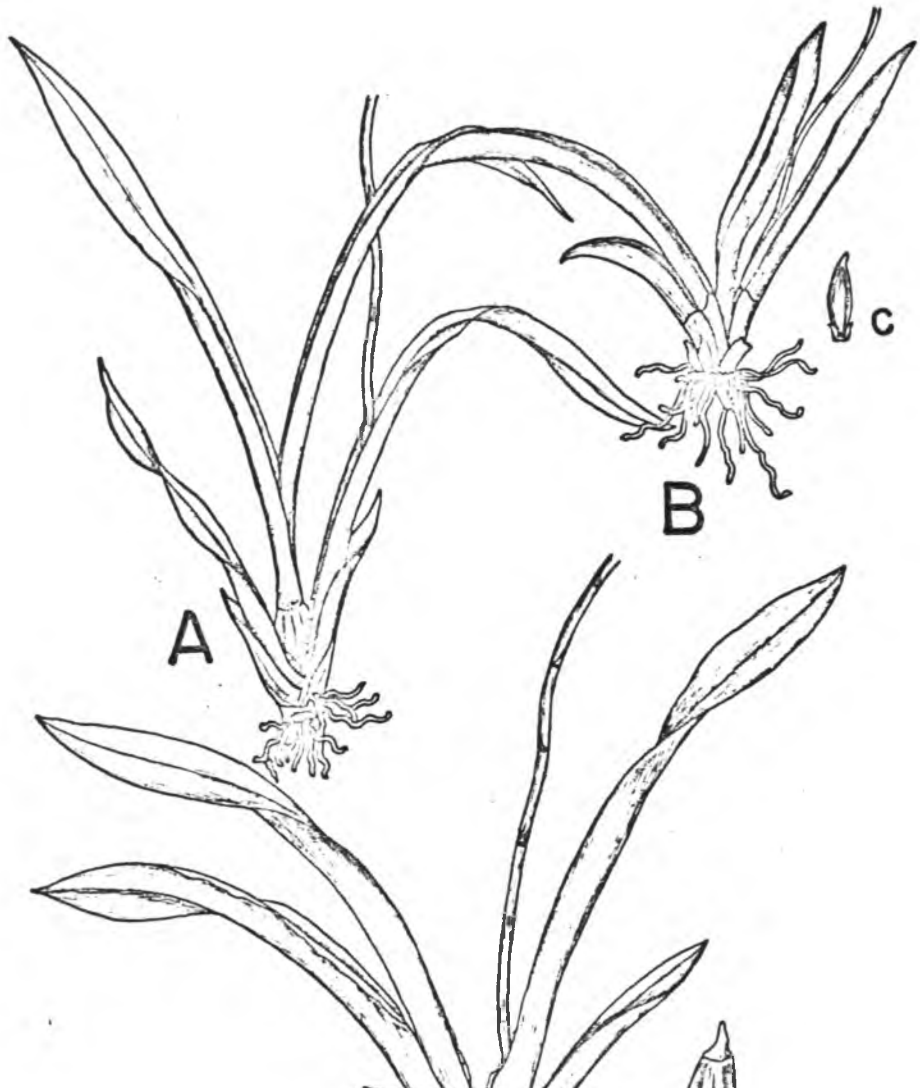

A
B
C
D
E

Plate XVII

Figure 17. Vegetative morphology of *Oncidium* species and their hybrid. A -- *O. microchilum*, plant, 1/2 X; B -- *O. onustum*, plant, 1 X; C -- *O. microchilum* x *O. onustum*, plant, 1/2 X

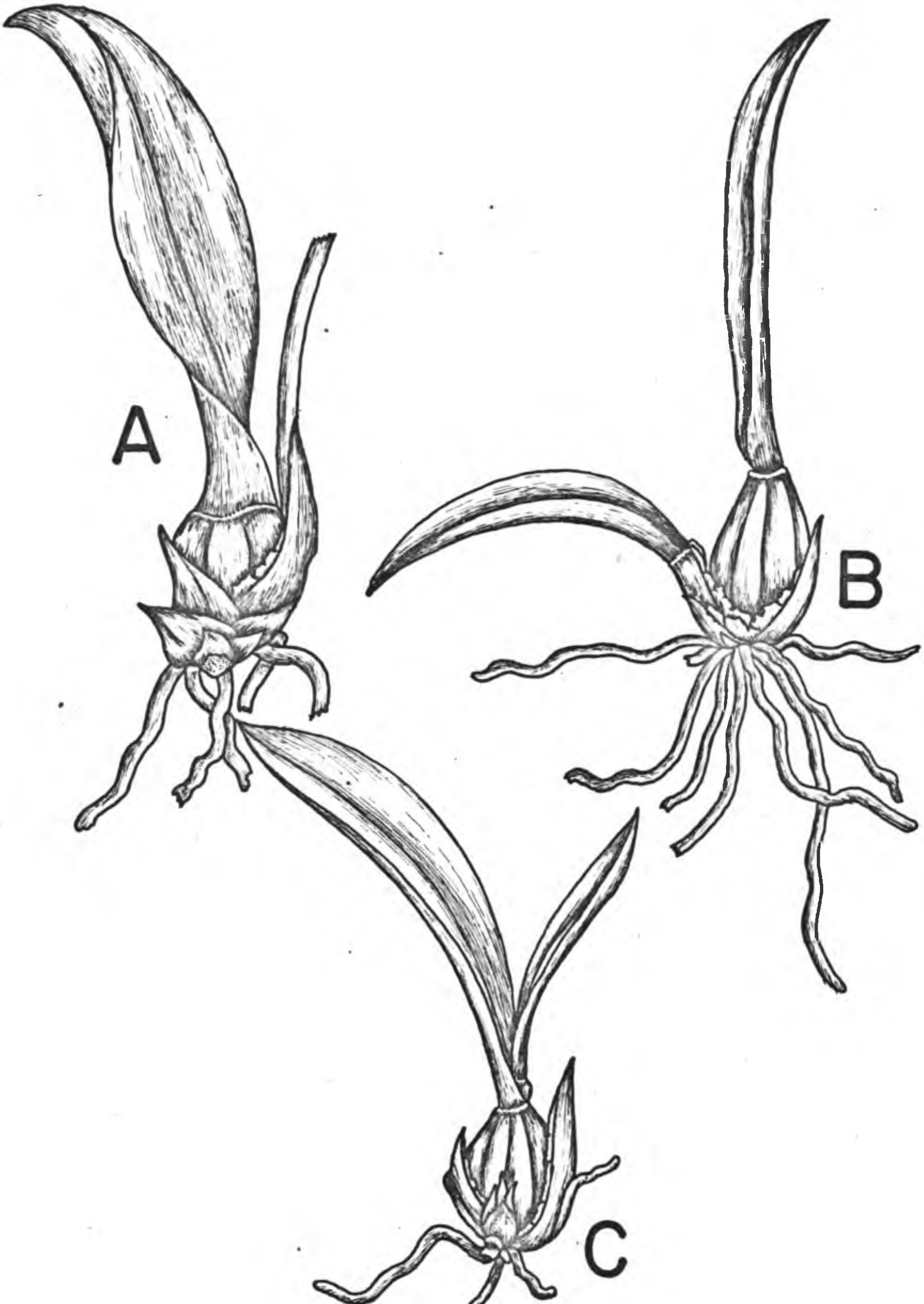

A
B
C

Plate XVIII

Figure 18. Vegetative morphology of *Oncidium* species and their hybrid. A -- *O. floridanum*, plant, 1/6 X; B -- *O. microchilum*, plant, 1/2 X; C -- *O. microchilum* x *O. floridanum*, plant, 1/3 X

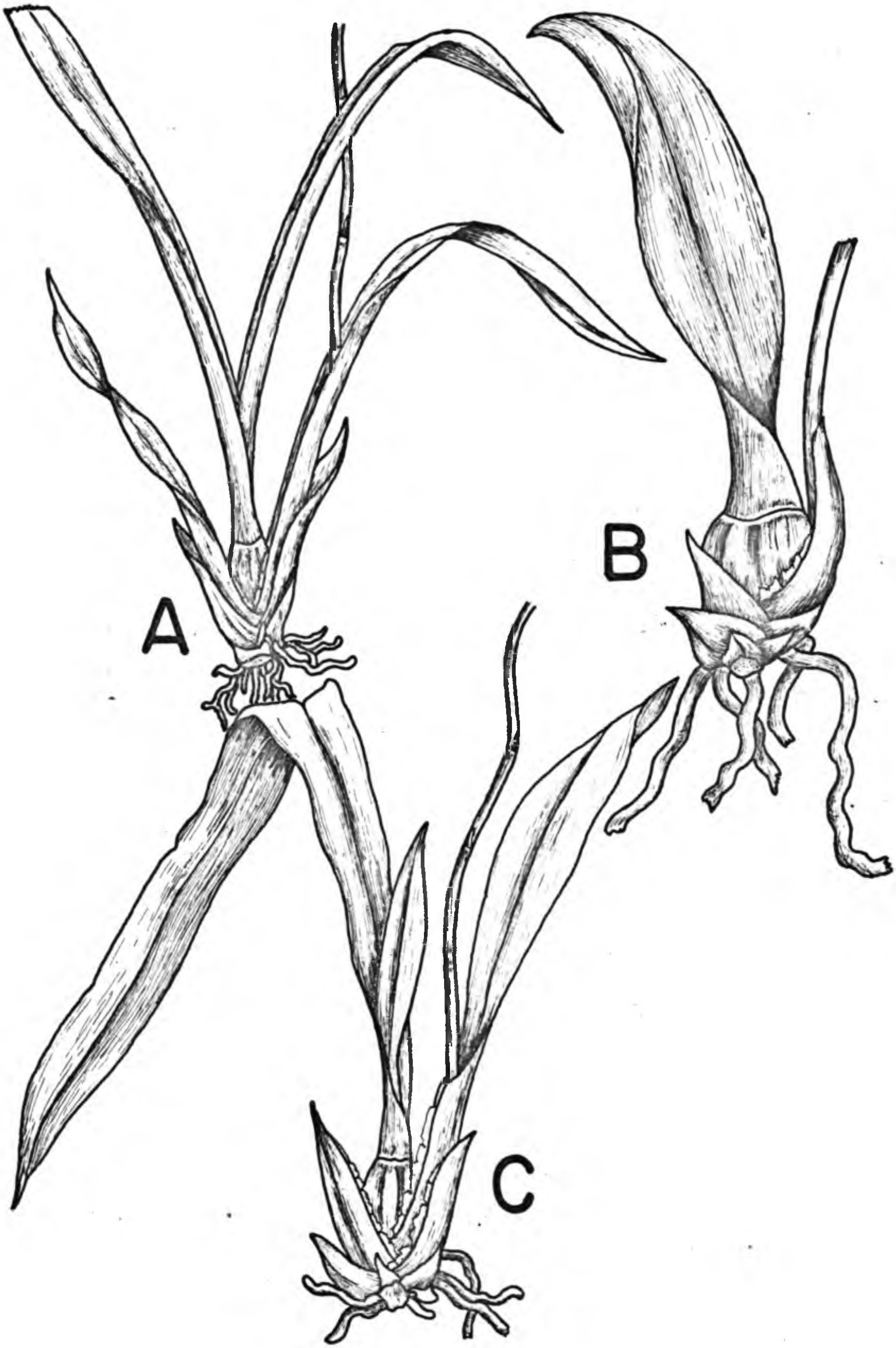
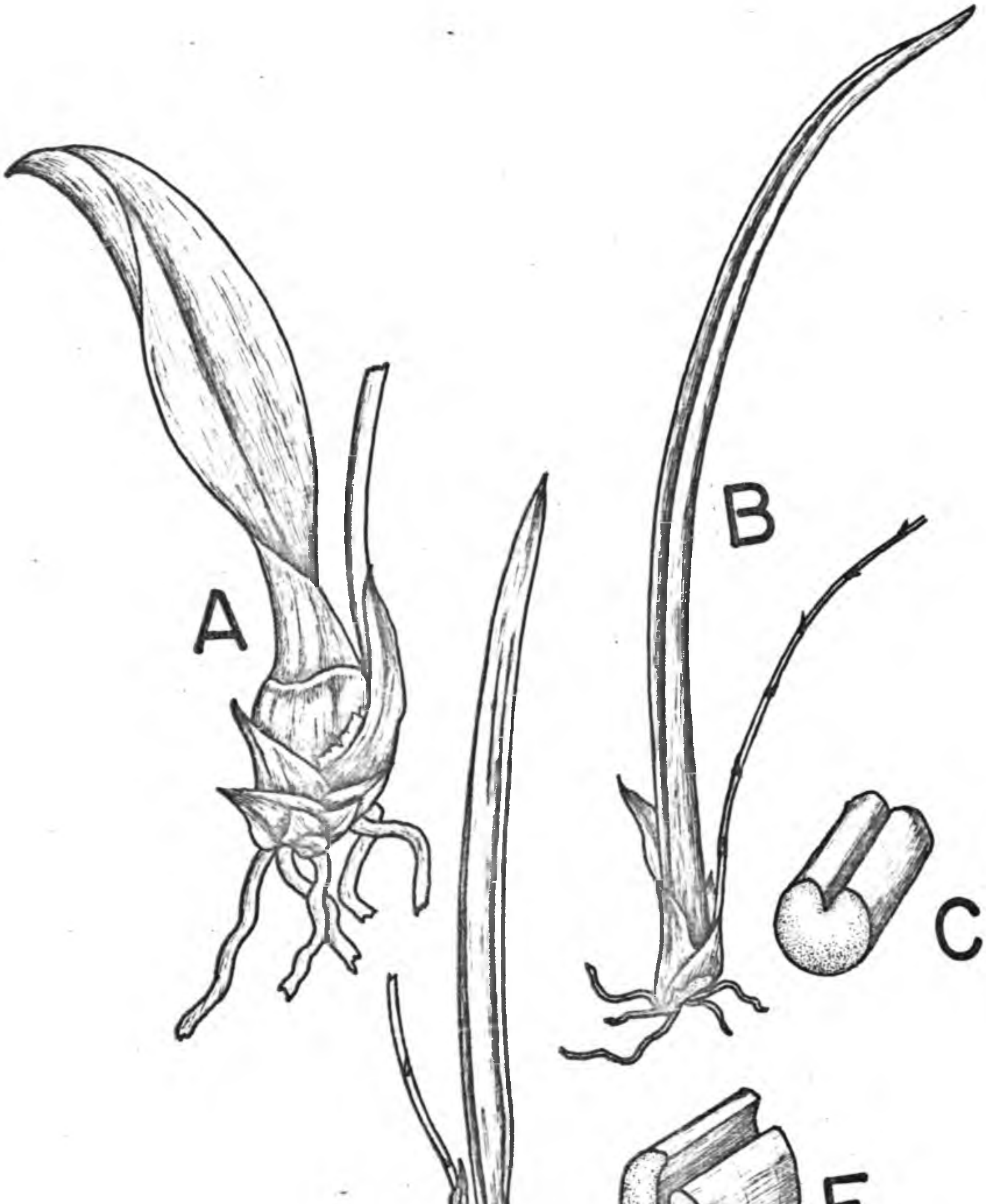

A
B
C

Plate XIX

Figure 19. Vegetative morphology of *Oncidium* species and their hybrid. A -- *O. microchilum*, plant, 1/2 X; B -- *O. nudum*, plant, 1/4 X; C -- *O. nudum*, cross section of leaf, 1 X; D -- *O. microchilum* x *O. nudum*, plant, 1/4 X; E -- *O. microchilum* x *O. nudum*, cross section of leaf, 1 X


A
B
C
D
E

RESULTS AND DISCUSSION

Intraspecific Self- and Cross-Pollination Studies

A total of 174 flowers from 33 *Oncidium* species, 2 *Brassia* spp., 1 *Miltonia* sp., 1 *Odontoglossum* sp., and 1 *Rodriguezia* sp. were self-pollinated. Forty-nine fruits were obtained which represented a 28.16% fruit set. Also 64 intraspecific cross-pollinations were made involving 17 *Oncidium*, spp., 1 *Brassia* sp., and 1 *Rodriguezia* sp. The percentage fruit set was 75.0 (Table II).

Based on 1 to 3 clones of each species investigated, *Brassia gireoudiana*, *Brassia caudata*, *Odontoglossum grande*, *Oncidium ansiferum*, *O. onustum*, *O. calochilum*, *O. desertorum*, *O. henekenii*, *O. pulchellum*, *O. tetrapetalum*, *O. variegatum*, *O. bicallosum*, *O. carthagenense*, *O. microchilum*, *O. splendidum*, *O. pulvinatum*, *O. leuchilum*, *O. maculatum*, *O. flexuosum*, *O. cebolleta*, *O. nudum*, *O. stipitatum*, *O. tigrinum*, and *Rodriguezia secunda* were found to be self- incompatible. All of the above species, except *Odontoglossum grande*, produced at least some viable seeds when out-crossed (Tables II, III, IV, V, and VI). Two plants of *O. lucayanum* set sterile fruits (Table II).

Miltonia roezlii, *Oncidium ensatum*, *O. floridanum*, *O. sarcodes*, *O. bahamense*, *O.* x *cubense*, *O. scandens*, *O. papilio*, *O. lanceanum*, *O. luridum*, and *O. ampliatum* were found to be self-compatible, producing fruits and viable seeds when self-pollinated.

Both self-incompatible and self-compatible clones were encountered in *Oncidium baueri* and *O. triquetrum*.

Although the samples used in this experiment were small, the results clearly indicate that for a large number of species in the subtribe

TABLE II

RESULTS OF SELF-POLLINATIONS AND INTRASPECIFIC CROSS POLLINATIONS IN THE *ONCIDIUM* ALLIANCE

Taxa	Type of pollination	No. of flowers pollinated	Fruit set No.	Fruit set %	% viable fruits	% developed embryos
Genus *Brassia*						
Sect. *Brassia*						
B. gireoudiana	selfed	2	0	0	-	-
B. caudata	Pl.1 selfed	2	0	0	-	-
	Pl.1 x Pl.2	2	2	100	100	90.5
Genus *Miltonia*						
Sect. *Miltoniopsis*						
M. roezlii	selfed	2	2	100	100	78.5
Genus *Odontoglossum*						
Sect. *Grandia*						
O. grande	selfed	1	0	0	-	-
Genus *Oncidium*						
Sect. *Altissima*						
O. ansiferum	selfed	2	0	0	-	-
O. baueri	Pl.1 selfed	2	0	0	-	-
	Pl.2 selfed	2	0	0	-	-
	Pl.3 selfed	2	2	100	100	92.5
	Pl.1 x Pl.2	2	2	100	100	95.5
	Pl.2 x Pl.1	2	2	100	100	98.0
O. ensatum	selfed	1	1	100	100	100.0
O. floridanum	Pl.1 selfed	3	3	100	100	99.0
	Pl.2 selfed	2	2	100	100	97.5
Sect. *Concoloria*						
O. onustum	Pl.1 selfed	2	0	0	-	-
	Pl.2 selfed	2	0	0	-	-
	Pl.1 x Pl.2	3	3	100	100	86.7
	Pl.2 x Pl.1	2	1	50	100	91.0

TABLE II. (Continued) RESULTS OF SELF-POLLINATIONS AND INTRASPECIFIC CROSS POLLINATIONS IN THE ONCIDIUM ALLIANCE

Taxa	Type of pollination	No. of flowers pollinated	Fruit set No.	Fruit set %	% viable fruits	% developed embryos
Genus *Oncidium* (cont.)						
Sect. *Crispa*						
O. sarcodes	selfed	4	4	100	100	34.0
Sect. *Equitantia*						
O. bahamense	Pl.1 selfed	2	2	100	100	87.5
	Pl.2 x Pl.3	2	2	100	100	100.0
	Pl.2 x Pl.4	2	2	100	100	95.5
O. calochilum	Pl.1 selfed	1	0	0	-	-
	Pl.1 x Pl.2	1	1	100	100	78.0
O. x cubense	selfed	2	2	100	100	93.5
O. desertorum	Pl.1 selfed	2	0	0	-	-
	Pl.2 selfed	2	0	0	-	-
	Pl.1 x Pl.3	2	2	100	100	97.0
O. henekenii	Pl.1 selfed	1	0	0	-	-
	Pl.1 x Pl.2	1	1	100	100	75.0
O. lucayanum	Pl.1 selfed	2	2	100	0	0
	Pl.2 selfed	7	2	28.5	0	0
	Pl.1 x Pl.2	2	0	0	-	-
	Pl.2 x Pl.1	2	0	0	-	-
O. pulchellum	selfed	2	0	0	-	-
O. scandens	selfed	4	4	100	100	93.5
O. tetrapetalum	selfed	2	0	0	-	-
O. triquetrum	Pl.1 selfed	2	0	0	-	-
	Pl.2 selfed	2	0	0	-	-
	Pl.3 selfed	4	2	50	100	72.0
	Pl.1 x Pl.3	2	2	100	100	99.0
	Pl.3 x Pl.1	2	2	100	100	100.0

TABLE II. (Continued) RESULTS OF SELF-POLLINATIONS AND INTRASPECIFIC CROSS POLLINATIONS IN THE ONCIDIUM ALLIANCE

Taxa	Type of pollination	No. of flowers pollinated	Fruit set No.	Fruit set %	% viable fruits	% developed embryos
Genus *Oncidium* (cont.)						
Sect. *Equitantia* (continued)						
O. variegatum	Pl.1 selfed	2	0	0	-	-
	Pl.2 selfed	2	0	0	-	-
	Pl.3 selfed	2	0	0	-	-
	Pl.2 x Pl.3	2	0	0	-	-
	Pl.3 x Pl.2	2	0	0	-	-
Sect. *Glanduligera*						
O. papilio	Pl.1 selfed	1	1	100	100	66.0
	Pl.1 x Pl.2	1	1	100	100	99.0
	Pl.2 x Pl.1	2	1	50.0	100	99.0
Sect. *Miltoniastrum*						
O. bicallosum	selfed	1	0	0	-	-
O. carthagenense	selfed	2	0	0	-	-
O. lanceanum	Pl.1 selfed	2	2	100	100	61.5
	Pl.1 x Pl.2	2	2	100	100	83.0
	Pl.1 x Pl.3	2	0	0	-	-
	Pl.2 x Pl.3	2	0	0	-	-
O. luridum	Pl.1 selfed	4	4	100	100	42.5
	Pl.2 selfed	4	4	100	100	92.25
	Pl.1 x Pl.2	2	2	100	100	96.0
	Pl.2 x Pl.1	2	2	100	100	94.0
O. microchilum	Pl.1 selfed	6	0	0	-	-
	Pl.2 selfed	6	0	0	-	-
	Pl.1 x Pl.2	2	2	100	100	80.0
	Pl.2 x Pl.1	2	2	100	100	83.5

TABLE II. (Continued) RESULTS OF SELF-POLLINATIONS AND INTRASPECIFIC CROSS POLLINATIONS IN THE ONCIDIUM ALLIANCE

Taxa	Type of pollination	No. of flowers pollinated	Fruit set No.	Fruit set %	% viable fruits	% developed embryos
Genus Oncidium (cont.)						
Sect. Miltoniastrum (continued)						
O. splendidum	Pl.1 selfed	2	0	0	-	-
	Pl.2 selfed	2	0	0	-	-
	Pl.2 x Pl.1	2	0	0	-	-
Sect. Pulvinata						
O. pulvinatum	selfed	2	0	0	-	-
Sect. Stellata						
O. leucochilum	selfed	2	0	0	-	-
O. maculatum	selfed	2	0	0	-	-
Sect. Synsepala						
O. flexuosum	selfed	2	0	0	-	-
Sect. Teretifolia						
O. cebolleta	2N selfed	2	0	0	-	-
	4N selfed	10	0	0	-	-
	2N x 4N	2	2	100	100	67.5
	4N x 2N	2	2	100	100	86.0
O. nudum	Pl.1 selfed	8	0	0	-	-
	Pl.2 selfed	10	0	0	-	-
	Pl.1 x Pl.2	2	2	100	100	97.0
	Pl.2 x Pl.1	2	2	100	100	96.0
O. stipitatum	Pl.1 selfed	8	0	0	-	-
	Pl.2 selfed	8	0	0	-	-
	Pl.3 selfed	16	0	0	-	-
	Pl.3 x Pl.2	4	4	100	100	99.25

TABLE II. (Continued) RESULTS OF SELF-POLLINATIONS AND INTRASPECIFIC CROSS POLLINATIONS IN THE *ONCIDIUM* ALLIANCE

Taxa	Type of pollination	No. of flowers pollinated	Fruit set No.	Fruit set %	% viable fruits	% developed embryos
Genus *Oncidium* (cont.)						
Sect. *Tigrina*						
O. tigrinum	selfed	1	0	0	-	-
Sect. Unclassified						
O. ampliatum	selfed	2	2	100	100	96.0
Genus *Rodriguezia*						
R. secunda	Pl.1 selfed	2	0	0	-	-
	Pl.1 x Pl.2	2	2	100	100	98.0

Oncidiinae self-incompatibility is a common phenomenon and cross pollination will yield a high percentage of fruit set.

Intrasectional Cross Compatibility within the Oncidium Genus

From a total of 269 intrasectional cross pollinations, 146 fruits were harvested, all of which resulted in at least some viable seeds. The fruit set and F_1 hybrid seed viability data are shown in tables III and IV respectively.

Six intrasectional combinations were attempted. *Stellata* x *Stellata* exhibited the highest percentage of fruit set, 100%, while *Concoloria* x *Concoloria* had the lowest, 0%. The remaining combinations *Teretifolia* x *Teretifolia*, *Miltoniastrum* x *Miltoniastrum*, *Equitantia* x *Equitantia*, and *Altissima* x *Altissima* had 89.1%, 61.9%, 40.0%, and 39.1% respectively (Table VII). For the combinations that produced fruits, *Teretifolia* x *Teretifolia* had the highest average percent apparently viable seeds, 96.6%, while *Miltoniastrum* x *Miltoniastrum* had the lowest, 73.0%. The other 3 combinations *Stellata* x *Stellata*, *Altissima* x *Altissima* and *Equitantia* x *Equitantia* had 95.0%, 85.3% and 79.8% viable seeds respectively (Table VII).

In the intrasectional combination *Altissima* x *Altissima*, 6 species were used. Four typical members, *O. altissimum*, *O. baueri*, *O. ensatum* and *O. floridanum*, crossed readily among themselves with 100% fruit set (Table III) and a high average viable seed percentage of 85.3 (Table VII). *Oncidium ansiferum*, which differs considerably from the above species in vegetative characteristics, failed to produce any fruit when crossed and accounted for the low percent fruit set for the group. However, *O. wertworthianum*, a species with vegetative parts typical of the section, failed to produce fruits in 2 crosses with *O. baueri*.

In intrasectional *Concoloria* x *Concoloria*, *O. concolor* x *O. onustum*

TABLE III

CROSS POLLINATIONS MADE AMONG *ONCIDIUM* SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. *Altissima*						Sect. *Barbata*
	altissima	*ansiferum*	*baueri*	*ensatum*	*floridanum*	*wentworthianum*	*micropogon*
Sect. *Altissima*							
ansiferum			4	2	2		
baueri	2(2)	2			2(2)	2	
ensatum		2			2(2)		
floridanum			2(2)	1(1)			
Sect. *Concoloria*							
onustum		4			2		2
Sect. *Crispa*							
sarcodes					4		
Sect. *Equitantia*							
desertorum					4		
pulchellum		4(4)			4		
triquetrum		4(2)	4		4(4)		
variegatum		4	2	2			
Sect. *Glanduligera*							
papilio		1	2				

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG *ONCIDIUM* SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. *Altissima*					
	altissima	*ansiferum*	*baueri*	*ensatum*	*floridanum*	*wentworthianum*
Sect. *Miltoniastrum*						
bicallosum			2			
carthagenense		2	2	2	2	
lanceanum			2		2	
luridum		2(2)	4(2)	4		
microchilum		4(2)		2	1(1)	
splendidum		2	2	2	3	
stramineum			2			
Sect. *Oblongata*						
isthmi	1(1)	2	4			
oblongatum		2	2			2
Sect. *Pulvinata*						
pulvinatum					3(3)	
Sect. *Stellata*						
leucochilum				2		
maculatum					1(1)	
Sect. *Synsepala*						
flexuosum					2	
Sect. *Teretifolia*						
cebolleta 2N					4	
cebolleta 4N		2		2	2	
nudum		2(1)			2	
Sect. Unclassifed						
ampliatum		2(2)		2	3	

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG ONCIDIUM SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♂ / ♀	Sect. Concoloria		Sect. Crispa	Sect. Eqiutantia			
	concolor	onustum	sarcodes	bahamense	calochilum	desertorum	henekenii
Sect. Altissima							
ansiferum		4	2				
baueri		2	2				
floridanum	2		4			2	
Sect. Concoloria							
concolor		2					
onustum	2		1			2	
Sect. Equitantia							
desertorum		6			1		
henekenii					1(1)		
lucayanum			1				
pulchellum		2(2)					2(1)
quadrilobium					1		
tetrapetalum		2				2(2)	
triquetrum		6(5)			1(1)	4(4)	
variegatum		4		2(2)		4	
Sect. Glanduligera							
papilio		1	3				

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG *ONCIDIUM* SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. *Concoloria*	Sect. *Crispa*	Sect. *Equitantia*			
	onustum	*sarcodes*	*desertorum*	*lucayanum*	*pulchellum*	*tetrapetalum*
Sect. *Miltoniastrum*						
bicallosum				1		
carthagenense	2(2)					
lanceanum	2				2	
luridum		4		2	2	2
microchilum	2(2)	4	2		2	
splendidum	3	2(1)			2	
stramineum		4		6	2	
Sect. *Oblongata*						
isthmi	2	2			2	
Sect. *Pulvinata*						
pulvinatum	3		4	1		2
Sect. *Stellata*						
leucochilum			2			2
maculatum	2					2(2)
Sect. *Synsepala*						
flexuosum					2	
Sect. *Teretifolia*						
cebolleta 2N	1	1				2
cebolleta 4N			2			2
nudum	2	4	2			4
stipitatum	3	2				
Sect. *Tigrina*						
tigrinum	2(1)					
Sect. Unclassified						
ampliatum	2(2)	3	2	2	2	

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG ONCIDIUM SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. Equitantia				
	lucayanum	pulchellum	quadrilobium	tetrapetalum	triquetrum
Sect. Altissima					
ansiferum		4			2
baueri		2			4
floridanum		2			4
Sect. Crispa					
sarcodes		2			2
Sect. Concoloria					
onustum		2		2	2
Sect. Equitantia					
bahamense					
desertorum	2		2	4	2
lucayanum		3			8
pulchellum	5(5)		2(2)	2(2)	2(2)
quadrilobium		2		2	
scandens					
tetrapetalum			2(2)		1(1)
triquetrum	5(5)	4		2(2)	
variegatum	4	6	2	2	8
Sect. Glanduligera					
papilio		1			

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG *ONCIDIUM* SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♂ / ♀	Sect. *Equitantia*		Sect. *Glanduligera*	Sect. *Miltoniastrum*	
	scandens	*variegatum*	*papilio*	*bicallosum*	*carthagenense*
Sect. *Altissima*					
ansiferum			2	2	2
baueri			2		4
floridanum					2
Sect. *Concoloria*					
onustum					4
Sect. *Crispa*					
sarcodes					2
Sect. *Equitantia*					
bahamense	2(2)				
lucayanum		6		2	
pulchellum		4(4)	2	2(2)	
scandens		2(2)			
tetrapetalum					2
triquetrum		4(4)	2	4	4(3)
variegatum				2	
Sect. Glanduligera					
papilio				1	

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG ONCIDIUM SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. Equitantia		Sect. Glanduligera	Sect. Miltoniastrum	
	triquetrum	variegatum	papilio	bicallosum	carthagenense
Sect. Miltoniastrum					
bicallosum	3		1		
carthagenense	2			2	
lanceanum					2
luridum	4	4	2	2	6(6)
microchilum	2		2	3(2)	2(2)
splendidum	1		2		1(1)
stramineum				3	2(2)
Sect. Oblongata					
oblongatum			2		
Sect. Pulvinata					
pulvinatum	2				
Sect. Stellata					
maculatum	2(2)		2		2
Sect. Synsepala					
flexuosum	2				
Sect. Teretifolia					
cebolleta 2N	2		2		
cebolleta 4N	2				2(1)
nudum	4		2		6(1)
stipitatum	2		2		
Sect. Unclassified					
ampliatum	2	2		2	2

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG ONCIDIUM SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. Miltoniastrum				
	lanceanum	luridum	microchilum	splendidum	stramineum
Sect. Altissima					
ansiferum		2	2(1)	2(2)	
baueri		2		5	2
ensatum		2		1	
floridanum	2	6	2	2	
Sect. Concoloria					
onustum	2	2	2	5	2
Sect. Crispa					
sarcodes		2			4
Sect. Equitantia					
desertorum			4		
lucayanum					4
pulchellum		2(1)			6(3)
tetrapetalum		2			
triquetrum	4	4(1)	4	2(1)	2(2)
variegatum		4			4
Sect. Glanduligera					
papilio	2		2	1(1)	

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG *ONCIDIUM* SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. *Miltoniastrum*				
	lanceanum	*luridum*	*microchilum*	*splendidum*	*stramineum*
Sect. *Miltoniastrum*					
bicallosum					1
carthagenense	2(2)	2(2)	2(1)	2(2)	2(2)
lanceanum		1(1)	1	1	1
luridum	2(2)		6(2)	4(4)	3(3)
microchilum	2(2)	4(4)		2(2)	2(2)
splendidum	4(3)	4	2(1)		
stramineum	1	3(3)	1(1)	6	
Sect. *Oblongata*					
oblongatum					
Sect. *Pulvinata*					
pulvinatum		2(2)	2(2)		
Sect. *Stellata*					
maculata		2	2	2	
Sect. *Synsepala*					
flexuosum	2		2		
Sect. *Teretifolia*					
cebolleta 2N		2	2	2(2)	
cebolleta 4N		8	4	2	
nudum		5		6(1)	
stipitatum				2	
Sect. *Unclassified*					
ampliatum		7(3)	2(1)		2(2)

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG *ONCIDIUM* SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. *Oblongata*		Sect. *Pulvinata*	Sect. *Stellata*		Sect. *Synsepala*
	isthmi	*oblongata*	*pulvinatum*	*leucochilum*	*maculatum*	*flexuosum*
Sect. *Altissima*						
ansiferum	2		2		2	
baueri	4(4)	2		3(1)	2(2)	
ensatum				2(2)		
floridanum	2	2	2	2	1(1)	2
Sect. *Concoloria*						
onustum	2		2		2	
Sect. *Crispa*						
sarcodes						2
Sect. *Equitantia*						
desertorum			4		4	
lucayanum			2(1)			
pulchellum						2(2)
tetrapetalum			2		2	
triquetrum	2		2	2(1)	5(5)	2(2)
variegatum	2		2		2	
Sect. *Glanduligera*						
papilio		2		2	1(1)	

TABLE III. (Continued) CROSS POLLINATIONS MADE AMONG *ONCIDIUM* SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. *Oblongata*		Sect. *Pulvinata*	Sect. *Stellata*		Sect. *Synsepala*
	isthmi	*oblongata*	*pulvinatum*	*leucochilum*	*maculatum*	*flexuosum*
Sect. *Miltoniastrum*						
carthagenense			2		2	
lanceanum						2
luridum			2	1	2	
microchilum			2		2(2)	
splendidum				2	2	
stramineum	2				2	
Sect. *Oblongata*						
isthmi				1(1)	2(2)	
Sect. *Pulvinata*						
pulvinatum				2(2)	2(2)	
Sect. *Stellata*						
leucochilum	2		1			
maculatum				2(2)		
Sect. *Teretifolia*						
cebolleta 2N			2		2	
cebolleta 4N			2		2(2)	
nudum					2	
Sect. Unclassified						
ampliatum	2(2)	2	2		2	2(1)

TABLE III. (Continued0 CROSS POLLINATIONS MADE AMONG <u>ONCIDIUM</u> SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Sect. Teretifolia				Sect. Tigrina	Sect. Unclassified
	cebolleta 2N	cebolleta 4N	nudum	stipitatum	tigrinum	ampliatum
Sect. Miltoniastrum						
carthagenense						2
lanceanum	2		4			2
luridum	2(2)	4(4)	10(10)	4(4)		7
microchilum		2(2)	2(2)			
splendidum		1(1)	3(3)	1(1)	1	2
stramineum	3(1)		4(2)	4(2)		2
Sect. Oblongata						
isthmi	2					2
oblongatum						2
Sect. Pulvinata						
pulvinatum		2(2)				
Sect. Stellata						
maculatum	2(2)	2(2)				
Sect. Synsepala						
flexuosum			2			2
Sect. Teretifolia						
cebolleta 2N			4(4)	2(2)		2(1)
cebolleta 4N			8(8)	2(2)		6
nudum	4(4)	8(8)		4(4)		4(2)
stipitatum	4(3)	4(2)	6(4)			3
Sect. Unclassified						
ampliatum	2(2)	4(4)	4(4)	3(3)		

TABLE III. (Continued- CROSS POLLINATIONS MADE AMONG <u>ONCIDIUM</u> SPECIES AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♂ / ♀	Sect. <u>Teretifolia</u>				Sect. <u>Tigrina</u>	Sect. Unclassified
	<u>cebolleta</u> 2N	<u>cebolleta</u> 4N	<u>nudum</u>	<u>stipitatum</u>	<u>tigrinum</u>	<u>ampliatum</u>
Sect. <u>Altissima</u>						
<u>ansiferum</u>	2(2)	2	4(2)	2(1)		2
<u>baueri</u>		4				2
<u>ensatum</u>		3				2
<u>floridanum</u>		6			2	3
Sect. <u>Concoloria</u>						
<u>onustum</u>	1	2	2	1	2	
Sect. <u>Equitantia</u>						
<u>bahamense</u>		2(2)				
<u>desertorum</u>	2	2	4			
<u>lucayanum</u>						2
<u>pulchellum</u>	2(2)		2(2)	2(2)		
<u>tetrapetallum</u>		2	4	2		
<u>triquetrum</u>	4(2)	2	4(2)	2(2)		3
<u>variegatum</u>				4		2
Sect. <u>Glanduligera</u>						
<u>papilio</u>		1	1			2

TABLE IV. PERCENTAGE VIABLE SEEDS OF INTERSPECIFIC CROSSES IN THE GENUS ONCIDIUM

♀ \ ♂	Sect. Altissima					Sect. Concoloria
	altissimum	ansiferum	baueri	ensatum	floridanum	onustum
Sect. Altissima						
baueri	74.0				99.0	
ensatum					99.0	
floridanum			62.0	100.0		
Sect. Equitantia						
henekenii						
pulchellum		11.25				14.0
triquetrum		3.0			49.0	17.8
variegatum						
Sect. Miltoniastrum						
carthagenense						0(v)
microchilum		23.0			45.0	27.0
luridum		85.0	58.5			
splendidum						
Sect. Oblongata						
isthmi	85.0					
Sect. Pulvinata						
pulvinatum					96.5	
Sect. Stellata						
maculata					100	
Sect. Teretifolia						
nudum		0(v)*				
Sect. Tigrina						
tigrinum						98.0
Sect. Unclassified						
ampliatum		15.0				14.0

* (v) following 0 indicates that some seedlings were germinated

TABLE IV. (Continued PERCENTAGE VIABLE SEEDS OF INTERSPECIFIC CROSSES IN THE GENUS *ONCIDIUM*

♀ \ ♂	Sect. *Crispa*	Sect. *Equitantia*			
	sarcodes	*bahamense*	*calochilum*	*desertorum*	*henekenii*
Sect. *Equitantia*					
henekenii			98.0		
pulchellum					84.0
tetrapetalum				97.5	
triquetrum			99.0	40.0	
variegatum		98.0			
Sect. *Miltoniastrum*					
splendidum	25.0				

TABLE IV. (Continued) PERCENTAGE VIABLE SEEDS OF INTERSPECIFIC CROSSES IN THE GENUS ONCIDIUM

♀ \ ♂	Sect. Equitantia					
	lucayanum	quadrilobium	tetrapetalum	triquetrum	scandens	variegatum
Sect. Equitantia						
bahamense					94.5	
pulchellum	76.8	81.0	83.0	94.0		88.0
tetrapetalum		64.0		67.0		
triquetrum	91.5		72.0			61.6
scandens						98.5
Sect. Stellata						
maculatum			3.5	0(v)		

TABLE IV. (Continued) PERCENTAGE VIABLE SEEDS OF INTERSPECIFIC CROSSES IN THE GENUS *ONCIDIUM*

♀ \ ♂	Sect. *Miltoniastrum*						
	bicallosum	*carthagenense*	*lanceanum*	*luridum*	*microchilum*	*splendidum*	*stramineum*
Sect. *Altissima*							
ansiferum					3.0	30.0	
baueri							
Sect. *Equitantia*							
pulchellum	47.0			0(v)			0(v)
triquetrum		0.3		0(v)		5.0	4.0
Sect. *Glanduligera*							
papilio						28.0	
Sect. *Miltoniastrum*							
carthagenense			26.0	97.0	97.0	82.0	97.5
lanceanum				1.0			
luridum		96.25	96.5		98.5	93.0	96.30
microchilum	21.0	76.0	71.5	83.5		52.0	82.5
splendidum		0(v)	17.7		16.0		
stramineum		76.5		76.7	74.0		
Sect. *Pulvinata*							
pulvinatum				83.5	98.0		
Sect. *Teretifolia*							
cebolleta 2N						19.5	
cebolleta 4N		11.0					
nudum		1.0				51.0	
Sect. Unclassified							
ampliatum				3.0	0(v)		7.0

TABLE IV. (Continued) PERCENTAGE VIABLE SEEDS OF INTERSPECIFIC CROSSES IN THE GENUS *ONCIDIUM*

♀ \ ♂	Sect. *Oblongata*	Sect. *Pulvinata*	Sect. *Stellata*		Sect. *Synsepala*
	isthmi	*pulvinatum*	*leucochilum*	*maculatum*	*flexuosum*
Sect. *Altissima*					
baueri	97.8		83.0	78.0	
ensatum			88.5		
floridanum				73.0	
Sect. *Equitantia*					
lucayanum		4.0			
pulchellum					28.0
triquetrum			0(v)	18.2	42.0
Sect. *Glanduligera*					
papilio				0	
Sect. *Miltoniastrum*					
microchilum				4.0	
Sect. *Oblongata*					
isthmi			97.0	90.0	
Sect. *Pulvinata*					
pulvinatum			92.5	96.0	
Sect. *Stellata*					
maculatum			95.0		
Sect. *Teretifolia*					
cebolleta 4N				20.0	
Sect. Unclassified					
ampliatum	0.5				0

TABLE IV. (Continued) PERCENTAGE VIABLE SEEDS OF INTERSPECIFIC CROSSES IN THE GENUS *ONCIDIUM*

♀ \ ♂	Sect. *Teretifolia*				Sect. Unclassified
	cebolleta 2N	*cebolleta* 4N	*nudum*	*stipitatum*	*ampliatum*
Sect. *Altissima*					
ansiferum	90.0		79.0	47.0	
baueri					
ensatum					
floridanum					
Sect. *Equitantia*					
bahamense		76.0			
lucayanum					
pulchellum	62.0		36.0	28.5	
triquetrum	14.0		11.0	0(v)	
Sect. *Glanduligera*					
papilio					
Sect. *Miltoniastrum*					
luridum	96.0	92.25	98.2	98.5	
microchilum		56.0	75.5		
splendidum		90.0	84.7	80.0	
stramineum	15.0		6.5	28.0	
Sect. *Oblongata*					
isthmi					
Sect. *Pulvinata*					
pulvinatum		98.0			
Sect. *Stellata*					
maculatum	97.0	73.5			
Sect. *Teretifolia*					
cebolleta 2N			94.0	94.0	45.0
cebolleta 4N			95.5	95.0	
nudum	95.0	98.0		98.0	89.0
stipitatum	98.3	96.0	100		
Sect. Unclassified					
ampliatum	0(v)	50.0	9.0	0(v)	

and its reciprocal cross failed although a successful cross was previously registered in the orchid hybrid list (Royal Horticultural Society, ed., 1972).

The undirectional cross compatibility exhibited by several interspecific combinations accounted for the relatively low percent fruit set, 40% in the intrasectional Equitantia x Equitantia crosses (Tables III and VII). The average percent viable seeds was a relatively high 79.8%, indicating the close affinity among the species successfully crossed. All the species in the section, except O. calochilum are very similar in vegetative characteristics. Oncidium calochilum has 2-3 distichous leaves in contrast to the typical Equitantia species that have three-edged leaves. However, crosses between O. calochilum and two other species in the section Equitantia gave 100% fruit set and 98-99% viable seeds indicating good cross compatibility relationships. The 42-chromosome species, including O. pulchellum, O. triquetrum and O. tetrapetalum crossed readily among themselves as well as with the 40-chromosome species, O. desertorum, O. lucayanum, O. quadrilobum and O. henekenii. All the interspecific pollinations attempted among the 40-chromosome species failed even though O. lucayanum x O. desertorum and O. variegatum x O. desertorum are both registered in the orchid hybrid lists.

The 7 species used in the section Miltoniastrum can be divided into two groups based on the difference in vegetative morphology: O. microchilum and O. splendidum with conspicuous pseudobulbs and both with 2n = 36 (Table IX), and O. lanceanum, O. bicallosum, O. carthagenense, O. luridum and O. stramineum with inconspicuous pseudobulbs and chromosome numbers ranging from 2n = 26 to 30 (Table IX). Undirectional cross compatibilities were also common among species in this section. O. luridum x O. splendidum produced 100% fruit set and 93.0% viable seed respectively, while its reciprocal gave 0% fruit set. When fruit set was successful in both directions, the percent viable seeds varied from 96.5 in O. luridum x O. lanceanum to 1.0 in the reciprocal cross. All attempts to reproduce hybrids which were recorded previously in the orchid hybrid lists were successful.

The only interspecific hybridization attempted within the section Stellata, O. maculatum x O. leucochilum, resulted in 100% fruit set and 95% non-aborted embryos. The reciprocal cross had been recorded in the orchid hybrid lists as a natural hybrid.

The three species in the section Teretifolia used in the investigation are similar in vegetative growth but differ from one another in minute details of floral structures, mainly the crests, the shape of the side-lobe of the labellum, and the shape of the column wings. Interspecific cross pollinations within Teretifolia produced 89.1% fruit set and an average of 96.6% non-aborted embryos indicating a close relationship among these terete-leaved species.

Intersectional and Intergeneric Hybridizations

From a total of 1,234 pollinations 255 fruits were harvested of which 243 resulted in viable seeds and, or offsprings. The pollinations were classified into intersectional hybridizations within the genus Oncidium and intergeneric hybridizations involving Brassia, Comparettia, Gomesa, Miltonia, Odontoglossum, Oncidium and Rodriguezia. The fruit set data do not seem to be indicative of the relationships among species, sections and genera involved in this investigation (Tables VII and VIII). On the other hand the percentage viable F_1 hybrid seeds appear to be a good indicator of species relationships.

Sixty-two intersectional crosses were made within the genus Oncidium and eleven of these involved O. ampliatum, which is not classified into a section. From 898 flowers pollinated 182 fruits were harvested of which 175 produced viable seeds and, or seedlings (Tables III and IV). Among the Oncidium intersectional crosses Concoloria x Tigrina and Pulvinata x Teretifolia gave the highest percentage of viable seeds, 98.0%. Synsepala x O. ampliatum and Glanduligera x Stellata did not produced any viable seeds. Thirty of the remaining 58 combinations formed viable seeds ranging from 0.5% to 97.8%, while the other 28 combinations failed to produce any fruits.

From a total of 336 pollinations representing 9 generic combinations, 73 fruits were harvested, of which 68 produced at least some viable seeds (Tables V and VI). These intergeneric hybridizations were classified into 71 combinations based on the sections involved (Table VIII). Thirty six of the 71 combinations resulted in fruit set and 34 in at least some viable seeds. Oncidium (sect. Pulvinata) x Rodriguezia and Odontoglossum

TABLE V. BIGENERIC CROSS POLLINATIONS MADE AMONG SPECIES OF THE ONCIDIUM ALLIANCE AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Brassia			Comparettia	Gomesa	Miltonia	
	Sect. Brassia		Sect. Glumaceae			Sect. Eumiltonia	Sect. Miltoniopsis
	caudata	gireoudiana	allenii	falcata	crispa	flavescens	roezlii
Brassia							
Sect. Brassia							
caudata						2(1)	
gireoudiana							1
Miltonia							
Sect. Eumiltonia							
flavescens	2(2)						
Sect. Miltoniopsis							
roezlii		2					
Odontoglossum							
Sect. Grandia							
grande							1
Sect. Xanthoglossum							
cariniferum		2					3
Rodriguezia							
venusta		4					
Oncidium							
Sect. Altissima							
ansiferum	2						
floridanum	2	2	2	2			4
Sect. Concoloria							
onustum		3		2			

TABLE V. (Continued) BIGENERIC CROSS POLLINATIONS MADE AMONG SPECIES OF THE ONCIDIUM ALLIANCE AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Brassia			Comparettia	Gomesa	Miltonia	
	Sect. Brassia		Sect. Glumaceae			Sect. Eumiltonia	Sect. Miltoniopsis
	caudata	gireoudiana	allenii	falcata	crispa	flavescens	roezlii
Oncidium (continued)							
Sect. Equitantia							
desertorum							3
pulchellum						2	
triquetrum	2			2(2)	2(2)	2	
Sect. Glanduligera							
papilio					1		
Sect. Miltoniastrum							
luridum	2	2			2	2	3
microchilum	2						2
splendidum		1					
Sect. Pulvinata							
pulvinatum				4(4)			
Sect. Stellata							
maculatum			2	2			
Sect. Teretifolia							
cebolleta 2N				2	2		
cebolleta 4N				4	4		3
nudum				2	2		
Sect. Unclassified							
ampliatum	2				1		

TABLE V. (Continued) BIGENERIC CROSS POLLINATIONS MADE AMONG SPECIES OF THE ONCIDIUM ALLIANCE AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Odontoglossum				Rodriguezia
	Sect. Grandia	Sect. Laevia	Sect. Trymenium	Sect. Xanthoglossum	
	grande	stenoglossum	citrosmum	cariniferum	venusta
Brassia					
Sect. Brassia					
gireoudiana				2	2(2)
Miltonia					
Sect. Miltoniopsis					
roezlii				2	
Oncidium					
Sect. Altissima					
ansiferum	2				
ensatum		2			4
floridanum		2			
Sect. Concoloria					
onustum					4
Sect. Crispa					
sarcodes	2				
Sect. Equitantia					
desertorum		3		4	
lucayanum				2	
triquetrum		2		3	4(4)

TABLE V. (Continued) BIGENERIC CROSS POLLINATIONS MADE AMONG SPECIES OF THE *ONCIDIUM* ALLIANCE AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	*Odontoglossum*				*Rodriguezia*
	Sect. *Grandia*	Sect. *Laevia*	Sect. *Trymenium*	Sect. *Xanthoglossum*	
	grande	*stenoglossum*	*citrosmum*	*cariniferum*	*venusta*
Sect. *Glanduligera*					
papilio	3				
Sect. *Miltoniastrum*					
carthagenense			2		
luridum	2		2	2	
microchilum	4			3(1)	
splendidum	2				1
Sect. *Pulvinata*					
pulvinatum		2(2)			2(1)
Sect. *Stellata*					
maculatum		2		2(2)	2(2)
Sect. *Teretifolia*					
cebolleta 4N				2	2
nudum					2
Sect. Unclassified					
ampliatum	2	4			3

TABLE V. (Continued) BIGENERIC CROSS POLLINATIONS MADE AMONG SPECIES OF THE ONCIDIUM ALLIANCE AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Oncidium					
	Sect. Altissima		Sect. Concoloria	Sect. Crispa	Sect. Glanduligera	Sect. Oblongata
	baueri	floridanum	onustum	sarcodes	papilio	isthmi
Brassia						
Sect. Brassia						
caudata		2	2			2
gireoudiana		3(3)	2			
Comparettia						
falcata		1(1)	2(2)			
Gomesa						
crispa			2(2)			
Miltonia						
Sect. Eumiltonia						
flavescens			2(1)	2(2)	1	3(3)
Odontoglossum						
Sect. Grandia						
grande	2	2		2	2	
Sect. Laevia						
stenoglossum			1			
Sect. Xanthoglossum						
cariniferum		2			2	
Rodriguezia						
venusta		4	2			

TABLE V. (Continued) BIGENERIC CROSS POLLINATIONS MADE AMONG SPECIES OF THE ONCIDIUM ALLIANCE AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	Oncidium				
	Sect. Equitantia				Sect. Pulvinata
	desertorum	lucayanum	pulchellum	triquetrum	pulvinatum
Brassia					
Sect. Brassia					
caudata					4
Comparettia					
falcata				2(2)	2
Gomesa					
crispa			2	2(2)	2
Miltonia					
Sect. Eumiltonia					
flavescens			3(2)	2(2)	2
Sect. Miltoniopsis					
roezlii	2(1)				
Odontoglossum					
Sect. Laevia					
stenoglossum	1(1)			1	
Sect. Xanthoglossum					
cariniferum		2		2	
Rodriguezia					
venusta				2	

TABLE V. (Continued) BIGENERIC CROSS POLLINATIONS MADE AMONG SPECIES OF THE *ONCIDIUM* ALLIANCE AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	*Oncidium*					
	Sect. *Miltoniastrum*					
	bicallosum	*carthagenense*	*luridum*	*microchilum*	*splendidum*	*stramineum*
Brassia						
Sect. *Brassia*						
caudata		2(2)				
gireoudiana			1(1)	1		
Gomesa						
crispa			2		2	
Miltonia						
Sect. *Eumiltonia*						
flavescens			2(2)		2	2(2)
Sect. *Miltoniopsis*						
roezlii		1(1)	2			
Odontoglossum						
Sect. *Grandia*						
grande	2(1)		2			1(1)
Sect. *Laevia*						
stenoglossum		1	1			
Sect. *Trymenium*						
citrosmum	1					2
Sect. *Xanthoglossum*						
cariniferum				2		

TABLE V. (Continued) BIGENERIC CROSS POLLINATIONS MADE AMONG SPECIES OF THE *ONCIDIUM* ALLIANCE AND NUMBER OF FRUITS OBTAINED (IN PARENTHESIS)

♀ \ ♂	*Oncidium*					
	Sect. *Stellata*		Sect. *Teretifolia*			Sect. Unclassified
	leucochilum	*maculatum*	*cebolleta* 2N	*cebolleta* 4N	*nudum*	*ampliatum*
Brassia						
Sect. *Eubrassia*						
caudata		2(1)	2	2	4	2
gireoudiana					2	
Sect. *Glumaceae*						
allenii		2		2		
Comparettia						
falcata		2(2)	1		2(1)	
Gomesa						
crispa			2(1)		2(2)	
Miltonia						
Sect. *Eumiltonia*						
flavescens	2(2)		2(2)		2(2)	2(2)
Sect. *Miltoniopsis*						
roezlii				2(2)		
Odontoglossum						
Sect. *Xanthoglossum*						
cariniferum		2		2		
Sect. *Laevia*						
stenoglossum		1(1)		1(1)	1(1)	1
Rodriguezia						
venusta					2	

TABLE VI. PERCENT VIABLE SEEDS OF INTERGENERIC CROSSES AMONG SPECIES IN THE ONCIDIUM ALLIANCE

♀ \ ♂	Brassia	Comparettia	Gomesa	Miltonia	Odontoglossum		Rodriguezia
	Sect. Eubrassia			Sect. Eumiltonia	Sect. Laevia	Sect. Xanthoglossum	
	caudata	falcata	crispa	flavescens	stenoglossum	cariniferum	venusta
Brassia							
Sect. Eubrassia							
B. caudata				97.0			
B. gireoudiana							0(v)*
Miltonia							
Sect. Eumiltonia							
M. flavescens	95.5						
Oncidium							
Sect. Equitantia							
O. triquetrum		18.0	13.0				63.5
Sect. Miltoniastrum							
O. microchilum						7.0	
Sect. Pulvinata							
O. pulvinata		4.0			99.0		0
Sect. Stellata							
O. maculatum						99.0	5.0

* (v) following 0 indicates that some seedlings were germinated

TABLE VI. (Continued) PERCENT VIABLE SEEDS OF INTERGENERIC CROSSES AMONG SPECIES IN THE *ONCIDIUM* ALLIANCE

♀ \ ♂	*Oncidium*					
	Altissima	*Concoloria*	*Crispa*	*Equitantia*		
	floridanum	*onustum*	*sarcodes*	*desertorum*	*pulchellum*	*triquetrum*
Brassia						
Sect. *Eubrassia*						
B. caudata						
B. gireoudiana	94.0					
Comparettia						
C. falcata	54.0	1.0				14.0
Gomesa						
G. crispa		100				88.0
Miltonia						
Sect. *Eumiltonia*						
M. flavescens		6.0	72.0		49.0	33.0
Sect. *Miltoniopsis*						
M. roezlii				75.0		
Odontoglossum						
Sect. *Grandia*						
O. grande						
Sect. *Laevia*						
O. stenoglossum			74.0			

TABLE VI. (Continued) PERCENT VIABLE SEEDS OF INTERGENERIC CROSSES AMONG SPECIES IN THE ONCIDIUM ALLIANCE

♀ \ ♂	Oncidium				
	Sect. Miltoniastrum				Sect. Oblongata
	bicallosum	carthagenense	luridum	stramineum	isthmi
Brassia					
Sect. Brassia					
gireoudiana		50.5	19.0		
Miltonia					
Sect. Eumiltonia					
flavescens			43.0	54.5	38.3
Sect. Miltoniopsis					
roezlii		32.0			
Odontoglossum					
Sect. Grandia					
grande	0			0	

TABLE VI. (Continued) PERCENT VIABLE SEEDS OF INTERGENERIC CROSSES AMONG SPECIES IN THE *ONCIDIUM* ALLIANCE

♀ \ ♂	*Oncidium*					
	Sect. *Stellata*		Sect. *Teretifolia*			Sect. Unclassified
	leucochilum	*maculatum*	*cebolleta* 2N	*cebolleta* 4N	*nudum*	*ampliatum*
Brassia						
Sect. *Eubrassia*						
B. caudata		0(v)				
B. gireoudiana						
Comparettia						
C. falcata		79.0			12.0	
Gomesa						
G. crispa			100.0		96.0	
Miltonia						
Sect. *Eumiltonia*						
M. flavescens	49.5		78.5		80.0	90.0
Sect. *Miltoniopsis*						
M. roezlii				2.0		
Odontoglossum						
Sect. *Grandia*						
O. grande						
Sect. *Laevia*						
O. stenoglossum		78.0		12.0	83.0	

grande x Oncidium (sect. Miltoniastrum) produced sterile fruits. Gomesa x Oncidium (sect. Concoloria) produced the highest percentage of viable seeds, 100%, while Brassia (sect. Brassia) x Oncidium (sect. Stellata) and Brassia (sect. Brassia) x Rodriguezia produced 0% viable seeds with a few seedlings observed when a large amount of seeds were germinated.

The sections Pulvinata, Oblongata, and Stellata of Oncidium and the section Brassia of the genus Brassia exhibited relatively high percent viable seeds from 96.5% to 84.1% among the taxa in the Oncidium alliance that produced fruits when crossed with the section Altissima of Oncidium (Tables VII and VIII). The genus Comparettia and the section Miltoniastrum of the genus Oncidium gave 54.0% and 44.1% developed embryos respectively, while the section Equitantia of Oncidium, and O. ampliatum produced low percentage of viable seeds, 24.7% and 13.5% respectively, when crossed with Oncidium sect. Altissima.

The section Concoloria of the genus Oncidium appeared to be more cross compatible with the genus Gomesa and the section Tigrina of the genus Oncidium than the rest of the taxa investigated. Crosses of Oncidium sect. Concoloria species with Gomesa and Oncidium sect. Tigrina species produced 100% and 98% viable seeds respectively. The sections Equitantia and Miltoniastrum, and Oncidium ampliatum of the unclassified section produced 16.7% to 13.5% viable seeds, while Miltonia (sect. Eumiltonia) and Comparettia crossed less successfully with Oncidium sect. Concoloria and formed only 6% and 1% viable seeds respectively.

Oncidium sarcodes, the only member of Oncidium sect. Crispa utilized produced 50% viable seeds when crossed with a member of Miltonia sect. Eumiltonia, but gave only 4.5% viable seeds when crossed with members of the section Miltoniastrum of the genus Oncidium.

TABLE VII. ONCIDIUM SECTIONAL CROSSES ATTEMPTED AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Sect. Altissima x Sect. Altissima	23	9	39.1	0	0	85.3
Sect. Altissima X Sect. Concoloria	8	0	0	-	-	-
Reciprocals	6	0	0	-	-	-
Crosses and Reciprocals	14	0	0	-	-	-
Sect. Altissima x Sect. Crispa	8	0	0	-	-	-
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	12	0	0	-	-	-
Sect. Altissima x Sect. Equitantia	20	0	0	-	-	-
Reciprocals	32	10	31.3	0	0	24.7
Crosses and Reciprocals	52	10	19.2	0	0	24.7
Sect. Altissima x Sect. Glanduligera	3	0	0	-	-	-
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	7	0	0	-	-	-
Sect. Altissima x Sect. Miltoniastrum	40	3	7.5	0	0	21.0
Reciprocals	42	7	16.7	0	0	54.0
Crosses and Reciprocals	82	10	12.2	0	0	44.1
Sect. Altissima x Sect. Oblongata	12	4	33.3	0	0	97.8
Reciprocals	13	1	7.7	0	0	85.0
Crosses and Reciprocals	25	5	20.0	0	0	95.2
Sect. Altissima x Sect. Pulvinata	4	0	0	-	-	-
Reciprocals	3	3	100	0	0	96.5
Crosses and Reciprocals	7	3	42.9	0	0	96.5
Sect. Altissima x Sect. Stellata	12	6	50.0	0	0	81.5
Reciprocals	3	1	33.3	0	0	100
Crosses and Reciprocals	15	7	46.7	0	0	84.1
Sect. Altissima x Sect. Synsepala	2	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	0	0	-	-	-

TABLE VII. (Continued) *ONCIDIUM* SECTIONAL CROSSES ATTEMPTED AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Sect. *Altissima* x Sect. *Teretifolia*	23	5	21.7	0	0	77.0
Reciprocals	14	1	7.1	0	0	0(v)*
Crosses and Reciprocals	37	6	16.2	0	0	64.2
Sect. *Altissima* x Sect. *Tigrina*	2	0	0	-	-	-
Sect. *Altissima* x *O. ampliatum*	9	0	0	-	-	-
Reciprocals	7	2	28.6	0	0	15.0
Crosses and Reciprocals	16	2	12.5	0	0	15.0
Sect. *Barbata* x Sect. *Concoloria*	-	-	-	-	-	-
Reciprocals	2	0	0	-	-	-
Sect. *Concoloria* x Sect. *Concoloria*	4	0	0	-	-	-
Sect. *Concoloria* x Sect. *Crispa*	1	0	0	-	-	-
Sect. *Concoloria* x Sect. *Equitantia*	8	0	0	-	-	-
Reciprocals	20	7	35.0	2	28.6	16.7
Crosses and Reciprocals	28	7	25.0	2	28.6	16.7
Sect. *Concoloria* x Sect. *Glanduligera*	-	-	-	-	-	-
Reciprocals	1	0	0	-	-	-
Sect. *Concoloria* x Sect. *Miltoniastrum*	17	0	0	-	-	-
Reciprocals	7	4	41	0	0	13.5
Crosses and Reciprocals	24	4	16.7	0	0	13.5
Sect. *Concoloria* x Sect. *Oblongata*	2	0	0	-	-	-
Reciprocals	2	0	0	0	-	-
Crosses and Reciprocals	4	0	0	-	-	-
Sect. *Concoloria* x Sect. *Pulvinata*	2	0	0	-	-	-
Reciprocals	3	0	0	-	-	-
Crosses and Reciprocals	5	0	0	-	-	-
Sect. *Concoloria* x Sect. *Stellata*	2	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	0	0	-	-	-

* (v) following 0 indicates that some seedlings were germinated.

TABLE VII. (Continued) ONCIDIUM SECTIONAL CROSSES ATTEMPTED AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set		Sterile Fruits		Average Percent Viable Seeds
		No.	%	No.	%	
Sect. Concoloria x Sect. Teretifolia	6	0	0	-	-	-
Reciprocals	6	0	0	-	-	-
Crosses and Reciprocals	12	0	0	-	-	-
Sect. Concoloria x Sect. Tigrina	2	0	0	-	-	-
Reciprocals	2	1	50.0	0	0	98.0
Crosses and Reciprocals	4	1	15.0	0	0	98.0
Sect. Concoloria x O. ampliatum	-	-	-	-	-	-
Reciprocals	2	2	100	0	0	14.0
Sect. Crispa x Sect. Equitantia	4	0	0	-	-	-
Reciprocals	1	0	0	-	-	-
Crosses and Reciprocals	5	0	0	-	-	-
Sect. Crispa x Sect. Glanduligera	-	-	-	-	-	-
Reciprocals	3	0	0	-	-	-
Sect. Crispa x Sect. Miltoniastrum	8	0	0	-	-	-
Reciprocals	14	1	7.1	0	0	25.0
Crosses and Reciprocals	22	1	4.5	0	0	25.0
Sect. Crispa x Sect. Oblongata	-	-	-	-	-	-
Reciprocals	2	0	0	-	-	-
Sect. Crispa x Sect. Synsepala	2	0	0	-	-	-
Sect. Crispa x Sect. Teretifolia	-	-	-	-	-	-
Reciprocals	7	0	0	-	-	-
Sect. Crispa x O. ampliatum	-	-	-	-	-	-
Reciprocals	3	0	0	-	-	-
Sect. Equitantia x Sect. Equitantia	110	44	40.0	0	0	79.8
Sect. Equitantia x Sect. Glanduligera	4	0	0	-	-	-
Reciprocals	1	0	0	-	-	-
Crosses and Reciprocals	5	0	0	-	-	-
Sect. Equitantia x Sect. Miltoniastrum	58	13	22.4	1	7.7	8.3
Reciprocals	39	0	0	-	-	-
Crosses and Reciprocals	97	13	13.4	1	7.7	8.3

TABLE VII. (Continued) ONCIDIUM SECTIONAL CROSSES ATTEMPTED AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Sect. Equitantia x Sect. Oblongata	4	0	0	-	-	-
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	8	0	0	-	-	-
Sect. Equitantia x Sect. Pulvinata	12	1	8.3	0	0	4.0
Reciprocals	9	0	0	-	-	-
Crosses and Reciprocals	21	1	4.8	0	0	4.0
Sect. Equitantia x Sect. Stellata	15	6	40.0	0	0	15.2
Reciprocals	8	4	50.0	0	0	1.8
Crosses and Reciprocals	23	10	43.5	0	0	9.8
Sect. Equitantia x Sect. Synsepala	4	4	100	0	0	35.0
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	8	4	50.0	0	0	35.0
Sect. Equitantia x Sect. Teretifolia	40	14	35.0	0	0	32.5
Reciprocals	22	0	0	-	-	-
Crosses and Reciprocals	62	14	22.6	0	0	32.5
Sect. Equitantia x O. ampliatum	7	0	0	-	-	-
Reciprocals	10	0	0	-	-	-
Crosses and Reciprocals	17	0	0	-	-	-
Sect. Glanduligera x Sect. Miltoniastrum	6	1	16.7	0	0	28.0
Reciprocals	7	0	0	-	-	-
Crosses and Reciprocals	13	1	7.7	0	0	28.0
Sect. Glanduligera x Sect. Oblongata	2	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	0	0	-	-	-
Sect. Glanduligera x Sect. Stellata	3	1	33.3	1	100	0
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	5	1	20.0	1	100	0
Sect. Glanduligera x Sect. Teretifolia	2	0	0	-	-	-
Reciprocals	6	0	0	-	-	-
Crosses and Reciprocals	8	0	0	-	-	-

TABLE VII. (Continued) ONCIDIUM SECTIONAL CROSSES ATTEMPTED AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Sect. Glanduligera x Sect. O. ampliatum	2	0	0	-	-	-
Sect. Miltoniastrum x Sect. Miltoniastrum	84	52	61.9	0	0	73.0
Sect. Miltoniastrum x Sect. Oblongata	2	0	0	-	-	-
Sect. Miltoniastrum x Sect. Pulvinata	-	-	-	-	-	-
Reciprocals	4	4	100	-	-	90.8
Sect. Miltoniastrum x Sect. Stellata	12	2	15.4	0	0	4.0
Reciprocals	8	0	0	-	-	-
Crosses and Reciprocals	21	2	9.5	0	0	4.0
Sect. Miltoniastrum x Sect. Synsepala	2	0	0	-	--	-
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	6	0	0	-	-	-
Sect. Miltoniastrum x Sect. Teretifolia	46	34	73.9	0	0	79.7
Reciprocals	41	5	12.2	0	0	18.0
Crosses and Reciprocals	87	39	44.8	0	0	71.8
Sect. Miltoniastrum x Sect. Tigrina	1	0	0	-	-	-
Sect. Miltoniastrum x Sect. O. ampliatum	15	0	0	-	-	-
Reciprocals	15	6	40.0	0	0	3.8
Crosses and Reciprocals	30	6	20.0	0	0	3.8
Sect. Oblongata x Sect. Stellata	3	3	100	0	0	92.3
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	5	3	66	0	0	92.3
Sect. Oblongata x Sect. Teretifolia	2	0	0	-	-	-
Sect. Oblongata x O. ampliatum	4	0	0	-	-	-
Reciprocals	4	2	50.0	0	0	0.5
Crosses and Reciprocals	8	2	25.0	0	0	0.5
Sect. Pulvinata x Sect. Stellata	4	4	100	0	0	94.3
Reciprocals	1	0	0	-	-	-
Crosses and Reciprocals	5	4	80	0	0	94.3

TABLE VII. (Continued) *ONCIDIUM* SECTIONAL CROSSES ATTEMPTED AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Sect. *Pulvinata* x Sect. *Teretifolia*	2	2	100	0	0	98.0
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	6	2	33.3	0	0	98.0
Sect. *Pulvinata* x *O. ampliatum*	2	0	0	-	-	-
Sect. *Stellata* x *Stellata*	2	2	100	0	0	95.0
Sect. *Stellata* x Sect. *Teretifolia*	4	4	100	0	0	85.3
Reciprocals	6	2	33.3	0	0	20.0
Crosses and Reciprocals	10	6	60.0	0	0	63.5
Sect. *Stellata* x *O. ampliatum*	-	-	-	-	-	-
Reciprocals	2	0	0	-	-	-
Sect. *Synsepala* x Sect. *Teretifolia*	2	0	0	-	-	-
Sect. *Synsepala* x Sect. *O. ampliatum*	2	0	0	-	-	-
Reciprocals	2	1	50.0	1	100	0
Crosses and Reciprocals	4	1	25.0	1	100	0
Sect. *Teretifolia* x Sect. *Teretifolia*	46	41	69.1	0	0	96.6
Sect. *Teretifolia* x *O. ampliatum*	15	3	20	0	0	74.3
Reciprocals	13	13	100	2	15.4	18.2
Crosses and Reciprocals	28	16	57.1	2	12.5	28.7

TABLE VIII. CROSSES ATTEMPTED AMONG DIFFERENT GENERA IN THE *ONCIDIUM* ALLIANCE AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set		Sterile Fruits		Average Percent Viable Seeds
		No.	%	No.	%	
Brassia sect. *Brassia*						
x *Miltonia* sect. *Eumiltonia*	2	1	50.0	0	0	97.0
Reciprocals	2	2	100	0	0	95.5
Crosses and Reciprocals	4	3	75.0	0	0	96.0
Brassia sect. *Brassia*						
x *Miltonia* sect. *Miltoniopsis*	1	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and reciprocals	3	0	0	-	-	-
Brassia sect. *Brassia*						
x *Odontoglossum* sect. *Xanthoglossum*	2	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	0	0	-	-	-
Brassia sect. *Brassia*						
x *Oncidium* sect. *Altissima*	5	3	60	0	0	94.0
Reciprocals	6	0	0	-	-	-
Crosses and Reciprocals	11	3	27.3	0	0	94.0
Brassia sect. *Brassia*						
x *Oncidium* sect. *Concoloria*	4	0	0	-	-	-
Reciprocals	3	0	0	-	-	-
Crosses and Reciprocals	7	0	0	-	-	-
Brassia sect. *Brassia*						
x *Oncidium* sect. *Equitantia*	-	-	-	-	-	-
Reciprocals	2	0	0	-	-	-
Brassia sect. *Brassia*						
x *Oncidium* sect. *Miltoniastrum*	4	3	75.0	0	0	40.0
Reciprocals	7	0	0	-	-	-
Crosses and Reciprocals	11	3	27.3	0	0	40.0
Brassia sect. *Brassia*						
x *Oncidium* sect. *Oblongata*	2	0	0	-	-	-

TABLE VIII. (Continued) CROSSES ATTEMPTED AMONG DIFFERENT GENERA IN THE ONCIDIUM ALLIANCE AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set		Sterile Fruits		Average Percent Viable Seeds
		No.	%	No.	%	
Brassia sect. Brassia						
x Oncidium sect. Pulvinata	4	0	0	-	-	-
Brassia sect. Brassia						
Oncidium sect. Stellata	2	1	50	0	0	0(v)*
Brassia sect. Brassia						
x Oncidium sect. Teretifolia	12	0	0	-	-	-
Brassia sect. Brassia						
x Oncidium ampliatum	2	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	0	0	-	-	-
Brassia sect. Glumaceae						
x Oncidium sect. Altissima	-	-	-	-	-	-
Reciprocals	2	0	0	-	-	-
Brassia sect. Glumaceae						
x Oncidium sect. Stellata	2	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	0	0	-	-	-
Brassia sect. Glumaceae						
x Oncidium sect. Teretifolia	2	0	0	-	-	-
Brassia sect. Brassia						
x Rodriguezia	2	2	100	0	0	0(v)
Comparettia						
x Oncidium sect. Altissima	1	1	100	0	0	54.0
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	3	1	33.3	0	0	54.0

* (v) following 0 indicates that some seedlings were germinated

TABLE VIII. (Continued) CROSSES ATTEMPTED AMONG DIFFERENT GENERA IN THE ONCIDIUM ALLIANCE AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Comparettia						
x Oncidium sect. Concoloria	2	2	100	0	0	1.0
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	2	50	0	0	1.0
Comparettia						
x Oncidium sect. Equitantia	2	2	100	0	0	14.0
Reciprocals	2	2	100	0	0	18.0
Crosses and Reciprocals	4	4	100	0	0	16.0
Comparettia						
x Oncidium sect. Pulvinata	4	4	100	0	0	4.0
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	6	4	66.7	0	0	4.0
Comparettia						
x Oncidium sect. Stellata	2	2	100	0	0	79.0
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	2	50.0	0	0	79.0
Comparettia						
x Oncidium sect. Teretifolia	3	1	33.3	0	0	12.0
Reciprocals	8	0	0	-	-	-
Crosses and Reciprocals	11	1	9.1	0	0	12.0
Gomesa						
x Oncidium sect. Concoloria	2	2	100	0	0	100
Gomesa						
x Oncidium sect. Equitantia	4	2	50	0	0	88.0
Reciprocals	2	2	100	0	0	13.0
Crosses and Reciprocals	6	4	66.7	0	0	50.5
Gomesa						
x Oncidium sect. Glanduligera	-	-	-	-	-	-
Reciprocals	1	0	0	0	-	-

TABLE VIII. (Continued) CROSSES ATTEMPTED AMONG DIFFERENT GENERA IN THE ONCIDIUM ALLIANCE AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Gomesa						
x Oncidium sect. Miltoniastrum	4	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	6	0	0	-	-	-
Gomesa						
x Oncidium sect. Pulvinata	2	0	0	-	-	-
Miltonia sect. Miltoniopsis						
x Oncidium sect. Altissima	-	-	-	-	-	-
Reciprocals	4	0	0	-	-	-
Miltonia sect. Miltoniopsis						
x Oncidium sect. Equitantia	2	1	50.0	0	0	75.0
Reciprocals	3	0	0	-	-	-
Crosses and Reciprocals	5	1	20.0	0	0	75.0
Miltonia sect. Eumiltonia						
x Oncidium sect. Crispa	4	2	50.0	0	0	72.0
Miltonia sect. Miltoniopsis						
x Oncidium sect. Miltoniastrum	3	1	33.3	0	0	32.0
Reciprocals	5	0	0	-	-	-
Crosses and Reciprocals	8	1	12.5	0	0	32.0
Miltonia sect. Miltoniopsis						
x Oncidium sect. Teretifolia	2	2	100	0	0	2.0
Reciprocals	3	0	0	-	-	-
Crosses and Reciprocals	5	2	50.0	0	0	2.0
Odontoglossum grande						
x Oncidium sect. Altissima	4	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Odontoglossum grande						
x Oncidium sect. Crispa	2	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	0	0	-	-	-

TABLE VIII. (Continued) CROSSES ATTEMPTED AMONG DIFFERENT GENERA IN THE ONCIDIUM ALLIANCE AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Odontoglossum grande						
x Oncidium sect. Glanduligera	2	0	0	-	-	-
Reciprocals	3	0	0	-	-	-
Crosses and Reciprocals	5	0	0	-	-	-
Odontoglossum grande						
x Oncidium sect. Miltoniastrum	5	2	25.0	2	100	0
Reciprocals	8	0	0	-	-	-
Crosses and Reciprocals	12	2	15.4	2	100	0
Gomesa						
x Oncidium sect. Teretifolia	4	3	75.0	0	0	98.0
Reciprocals	8	0	0	-	-	-
Crosses and Reciprocals	12	3	25.0	0	0	98.0
Gomesa						
x Oncidium ampliatum	-	-	-	-	-	-
Reciprocals	1	0	0	-	-	-
Miltonia sect. Eumiltonia						
x Oncidium sect. Concoloria	2	1	50.0	0	0	6.0
Miltonia sect. Eumiltonia						
x Oncidium sect. Equitantia	5	4	80.0	0	0	41.0
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	9	4	44.4	0	0	41.1
Miltonia sect. Eumiltonia						
x Oncidium sect. Miltoniastrum	6	4	66.7	0	0	48.3
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	8	4	50.0	0	0	48.3
Miltonia sect. Eumiltonia						
x Oncidium sect. Glanduligera	1	0	0	-	-	-
Miltonia sect. Eumiltonia						
x Oncidium sect. Oblongata	3	3	100	0	0	38.3

TABLE VIII. (Continued) CROSSES ATTEMPTED AMONG DIFFERENT GENERA IN THE ONCIDIUM ALLIANCE AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Miltonia sect. *Eumiltonia*						
x *Oncidium* sect. *Pulvinata*	2	0	0	-	-	-
Miltonia sect. *Eumiltonia*						
x *Oncidium* sect. *Stellata*	2	2	100	0	0	49.5
Miltonia sect. *Eumiltonia*						
x *Oncidium* sect. *Teretifolia*	4	4	100	0	0	79.3
Miltonia sect. *Eumiltonia*						
x *Oncidium ampliatum*	2	2	100	0	0	90.0
Odontoglossum grande						
x *Oncidium ampliatum*	-	-	-	-	-	-
Reciprocals	2	0	0	-	-	-
Odontoglossum stenoglossum						
x *Oncidium* sect. *Altissima*	-	-	-	-	-	-
Reciprocals	4	0	0	-	-	-
Odontoglossum stenoglossum						
x *Oncidium* sect. *Concoloria*	1	0	0	-	-	-
Odontoglossum stenoglossum						
x *Oncidium* sect. *Equitantia*	2	1	50.0	0	0	74.0
Reciprocals	5	0	0	-	-	-
Crosses and Reciprocals	7	1	14.3	0	0	74.0
Odontoglossum stenoglossum						
x *Oncidium* sect. *Miltoniastrum*	2	0	0	-	-	-
Odontoglossum stenoglossum						
x *Oncidium* sect. *Pulvinata*	-	-	-	-	-	-
Reciprocals	2	2	100	0	0	99.0
Odontoglossum stenoglossum						
x *Oncidium* sect. *Stellata*	1	1	100	0	0	78.0
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	3	1	33.3	0	0	78.0

TABLE VIII. (Continued) CROSSES ATTEMPTED AMONG DIFFERENT GENERA IN THE ONCIDIUM ALLIANCE AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set No.	Fruit Set %	Sterile Fruits No.	Sterile Fruits %	Average Percent Viable Seeds
Odontoglossum stenoglossum x Oncidium sect. Teretifolia	2	2	100	0	0	47.5
Odontoglossum stenoglossum x Oncidium ampliatum	4	0	0	-	-	-
Reciprocals	1	0	0	-	-	-
Crosses and Reciprocals	5	0	0	-	-	-
Odontoglossum citrosmum x Oncidium sect. Miltoniastrum	3	0	0	-	-	-
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	7	0	0	-	-	-
Odontoglossum cariniferum x Oncidium sect. Altissima	2	0	0	-	-	-
Odontoglossum cariniferum x Oncidium sect. Equitantia	4	0	0	-	-	-
Reciprocals	9	0	0	-	-	-
Crosses and Reciprocals	13	0	0	-	-	-
Odontoglossum cariniferum x Oncidium sect. Glanduligera	2	0	0	-	-	-
Odontoglossum cariniferum x Oncidium sect. Miltoniastrum	2	0	0	-	-	-
Reciprocals	3	1	33.3	0	0	7.0
Crosses and Reciprocals	5	1	20.0	0	0	7.0
Odontoglossum cariniferum x Oncidium sect. Stellata	2	0	0	-	-	-
Reciprocals	2	2	100	0	0	99.0
Crosses and Reciprocals	4	2	50.0	0	0	99.0
Odontoglossum cariniferum x Oncidium sect. Teretifolia	2	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	4	0	0	-	-	-

TABLE VIII. (Continued) CROSSES ATTEMPTED AMONG DIFFERENT GENERA IN THE ONCIDIUM ALLIANCE AND RESULTS

Taxa Crossed	No. of Crosses attempted	Fruit Set		Sterile Fruits		Average Percent Viable Seeds
		No.	%	No.	%	
Oncidium sect. Altissima						
x Rodriguezia	4	0	0	-	-	-
Reciprocals	4	0	0	-	-	-
Crosses and Reciprocals	8	0	0	-	-	-
Oncidium sect. Concoloria						
x Rodriguezia	4	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	6	0	0	-	-	-
Oncidium sect. Equitantia						
x Rodriguezia	4	4	100	-	-	63.5
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	6	4	66.7	0	0	63.5
Oncidium sect. Miltoniastrum						
x Rodriguezia	1	0	0	-	-	-
Oncidium sect. Pulvinata						
x Rodriguezia	2	1	50.0	1	100	0
Oncidium sect. Stellata						
x Rodriguezia	2	2	100	0	0	5.0
Oncidium sect. Teretifolia						
x Rodriguezia	4	0	0	-	-	-
Reciprocals	2	0	0	-	-	-
Crosses and Reciprocals	6	0	0	-	-	-

Oncidium sect. Equitantia appeared to be more cross compatible with Miltonia (sect. Miltoniopsis), Rodriguezia and Gomesa than other taxa in the Oncidium alliance. The intergeneric pollinations of Oncidium sect. Equitantia with Miltonia (sect. Miltoniopsis), Rodriguezia and Gomesa produced 75.0%, 63.5% and 50.5% viable seeds, respectively. The Eumiltonia section of the genus Miltonia, the sections Synsepala, Teretifolia and Altissima of the genus Oncidium produced 41.1%, 35.0% and 24.7% nonaborted embryos respectively when crossed with the Equitantia section of Oncidium. The section Concoloria of Oncidium and the genus Comparettia produced 16.7% and 16.0% viable seeds, respectively, with Oncidium sect. Equitantia. Oncidium intrageneric crosses of the sections Stellata, Miltoniastrum, and Pulvinata crossed with the section Equitantia produced low percentages of viable seeds, 9.8%, 8.3% and 4.0% respectively.

The Glanduligera section of Oncidium with its distinct floral morphology produced viable seeds only when crossed with the section Miltoniastrum of the same genus. The only other cross involving the Glanduligera section of Oncidium which ever produced fruits was between Oncidium sect. Glanduligera and sect. Stellata which produced 20.0% sterile fruits.

The Miltoniastrum section of Oncidium appeared to be more cross compatible to the sections Pulvinata, and Teretifolia than the rest of the sections in the same genus and related genera. The crosses Oncidium sect. Miltoniastrum x Oncidium sect. Pulvinata and Miltoniastrum x Teretifolia produced 90.0% and 71.8% viable seeds respectively. The section Eumiltonia of the genus Miltonia, the section Eubrassia of the

Brassia genus, the section *Altissima* of *Oncidium*, the section *Miltoniopsis* of *Miltonia* and the section *Glanduligera* of *Oncidium* when crossed with *Oncidium* sect. *Miltoniastrum* gave lower percentage of viable seeds ranging from 48.3% to 28.0%. The sections *Concoloria*, *Equitantia*, *Crispa*, and *Stellata* of *Oncidium*, *Oncidium ampliatum* and *Odontoglossum cariniferum* crossed with *Miltoniastrum Oncidium* resulted in only 13.5% to 3.8% viable seeds.

The section *Oblongata* of the genus *Oncidium* when crossed with the sections *Altissima* and *Stellata* of the same genus gave 95.0% and 92.3% viable seeds respectively. Successful crosses were also obtained between *Oncidium* sect. *Oblongata* and both *Miltonia* sect. *Eumiltonia* and *Oncidium ampliatum* with 38.3% and 0.5% viable seeds respectively.

The section *Pulvinata* of the *Oncidium* genus produced very high percentages of viable seeds ranging from 99% to 90% when crossed with *Odontoglossum stenoglossum*, and the sections *Teretifolia*, *Altissima*, and *Miltoniastrum* of *Oncidium*. The *Pulvinata* section of *Oncidium* crossed less successfully with only 4.0% viable seeds with the section *Equitantia* of the same genus and *Comparettia*. *Rodriguezia* produced fruits when crossed with *Oncidium* sect. *Pulvinata* but did not produce any viable seeds or seedlings.

The pollinations of *Stellata* section of *Oncidium* with *Odontoglossum cariniferum*, *Oncidium* sections *Oblongata* and *Altissima* and *Odontoglossum stenoglossum* produced high percentages of viable seeds ranging from 99.0% to 78.0%. The vegetative morphology of all of these taxa is similar. They have one-node pseudobulbs, basal leaves at the base of the pseudobulbs, and one or two leaves on the top of the pseudobulbs. The chromosome numbers of these species are 2n = 56. However, the cross

Oncidium sect. Stellata x Comparettia also produced a relatively high percentage of viable seed, 79.0%, despite the distinct floral and vegetative morphology and chromosome number of the genus Comparettia. Oncidium sect. Stellata x Oncidium sect Teretifolia and Oncidium sect. Stellata x Miltonia sect. Eumiltonia produced 63.5% and 49.5% viable seeds respectively. Oncidium sect. Stellata gave relatively low percentages of developed embryos when crossed with Oncidium sect. Equitantia, Rodriguezia, Miltonia sect. Miltoniopsis and Brassia sect. Brassia.

Oncidium sect. Synsepala x Oncidium sect. Equitantia produced 35.0% developed embryos. These two groups have lateral sepals in a synsepalum, but they have very different vegetative characteristics and chromosome numbers.

The crosses between section Teretifolia of Oncidium and both sections Pulvinata and Miltoniastrum of the same genus gave relatively high percentages of viable seeds, 98.0% and 71.8% respectively. However, the crosses between Oncidium sect. Teretifolia with Gomesa, Miltonia sect. Eumiltonia, the sections Altissima and Stellata of Oncidium and Odontoglossum stenoglossum had relatively high percentages of viable seeds ranging from 98.0% to 47.5%, although Oncidium sect. Teretifolia is much different from those taxa in both floral and vegetative morphology. The crosses between the section Teretifolia of Oncidium with the section Equitantia of Oncidium, Oncidium ampliatum, Comparettia and the section Miltoniopsis of Miltonia ranged from 32.7% to 2.0% viable seeds.

Oncidium ampliatum x Miltonia sect. Eumiltonia produced 90.0% viable seeds although the two taxa have diverse floral and vegetative morphology.

Oncidium ampliatum x Oncidium sect. Teretifolia gave 28.7% viable seeds. The crosses between Oncidium ampliatum with members of the sections Altissima, Concoloria, Miltoniastrum and Oblongata produced from 14.0% to 0.5% viable seeds.

The crosses between section Brassia of the genus Brassia with the section Eumiltonia and the section Altissima of the Genus Oncidium produced very high percentage of viable seeds, 96.0% and 94.0% respectively. Brassia sect. Brassia x Oncidium sect. Miltoniastrum gave 40.0% viable seeds while Brassia sect. Brassia x Oncidium sect. Stellata and Brassia sect. Brassia x Rodriguezia both had 0% viable seeds. However, when a large amount of seeds were germinated a few seedlings were observed in both crosses.

The genus Comparettia has miniature vegetative and floral characteristics and a distinct spur on the flower. The Comparettia x Oncidium sect. Stellata and Comparettia x Oncidium sect. Altissima combinations produced 79.0% and 54.0% viable seeds respectively. Both sections, Stellata and Altissima, of Oncidium are morphologically distinct from Comparettia, but the difference in external morphology does not appear to be reflected in their crossability. The crosses between Comparettia and the sections Concoloria, Pulvinata, Teretifolia, and Equitantia produced relatively low percentages of viable seeds ranging from 16.0% to 1.0%.

The crosses between Gomesa and members of the sections Teretifolia and Concoloria of the genus Oncidium gave 98.0% and 100% viable seeds respectively. The cross Gomesa x Equitantia Oncidium produced 50.5% viable embryos. Although these three sections of Oncidium are considerably different from Gomesa in both vegetative and floral morphology, they were highly cross compatible.

The section Eumiltonia of the genus Miltonia when crossed with Oncidium ampliatum, and the section Brassia of the genus Brassia produced 96.0% and 90.0% viable embryos, respectively. The crosses between Miltonia sect. Eumiltonia and Oncidium sect. Teretifolia produced relatively high percentage of viable seeds, 79.3%, while the crosses between the Eumiltonia section of Miltonia and the sections Oblongata, Miltoniastrum, Equitantia and Stellata of Oncidium gave 49.5% to 38.3% nonaborted embryos. The crosses between a member of the section Eumiltonia of the genus Miltonia and a member of the section Concoloria of the genus Oncidium produced the lowest percentage of developed embryos of all the crosses involving Miltonia sect. Eumiltonia, 6.0%.

The crosses between the section Miltoniopsis of the genus Miltonia and the sections Equitantia and Crispa of Oncidium produced 75.0% and 72.0% viable seeds, respectively. Miltonia sect. Miltoniopsis x Oncidium sect. Miltoniastrum gave 32.0% viable seeds, while Miltonia sect. Miltoniopsis x Oncidium sect. Teretifolia exhibited the lowest percentage of developed embryos of all the crosses involving Miltonia sect. Miltoniopsis, 2.0%.

Odontoglossum grande x Oncidium sect. Miltoniastrum produced sterile fruits, while all other crosses involving Odontoglossum grande failed to produced any fruit.

Odontoglossum stenoglossum x Oncidium sect. Pulvinata exhibited 99.0% viable seeds.

Odontoglossum stenoglossum x Oncidium sect. Stellata and Odontoglossum stenoglossum x Oncidium sect. Equitantia, gave 78.0% and

74.0% viable seeds respectively, while Odontoglossum stenoglossum x Oncidium sect. Teretifolia produced 47.5% viable seeds.

Rodriguezia appeared to be more cross compatible with the section Equitantia of the genus Oncidium than all the other taxa used. Rodriguezia x Oncidium sect. Equitantia produced 63.5 viable seeds. Oncidium sect. Stellata x Rodriguezia gave only 5.0% viable seeds, while Brassia sect. Brassia x Rodriguezia produced a few viable seedlings. The cross Oncidium sect. Pulvinata x Rodriguezia produced a fruit with nonviable seeds.

All crosses involving Oncidium micropogon, Oncidium concolor, Odontoglossum grande, Odontoglossum citrosmum, and Brassia allenii failed to produce viable F_1 hybrid seeds (Tables III, IV, V and VI). All interspecific and intergeneric crosses involving Oncidium onustum, Oncidium sarcodes, Oncidium desertorum, Oncidium quadrilobum, Odontoglossum cariniferum, and Rodriguezia venusta as seed parents failed to produce any fruits and seeds.

The result of interspecific, intersectional and intergeneric hybridizations showed the trend of unidirectional crossabilities. In many cross combinations the crosses and their respective reciprocal crosses usually resulted in much different percentages of fruit set (Tables III, V, VII, and VIII). In a few combinations of interspecific, intersectional and intergeneric hybridizations, the crosses and their respective reciprocal crosses exhibited drastically different percentages of viable seeds (Tables IV, V, VII and VIII).

The classification of species in the Oncidium alliance into different sections and genera based on external morphology does not appear to be correlated with the crossability relationships. In many instances species crossed as readily between sections as within sections and as readily between genera as within genera. However, the results of the present investigation provide additional evidence on the degree of relationships among the species utilized in the hybridizations.

<u>Chromosome Numbers</u>

The chromosome numbers of 53 species representing 13 genera of the *Oncidium* alliance of the subtribe Oncidiinae were determined (Table IX, Figs. 20-43). The chromosome numbers of the following 17 species are reported for the first time: *Ada elegentula* 2n = 60, *Aspasia epidendroides* 2n = 60, *Lockhartia micrantha* 2n = 56, *Oncidium micropogon* 2n = 56, *O.* x *ann-hadderiae* 2n = 42, *O. calochilum* 2n = 42, *O.* x *cubense* 2n = 42, *O.* x *floride-phillepsiae* 2n = 126, *O. jimenezii* 2n = 42, *O. lemonianum* 2n = 42, *O. quadrilobum* 2n = 40, *O.* x *varvelum* 2n = 63, *O. velutinum* 2n = 84, *O. liminghei* 2n = 56, *Ornithophora radicans* 2n = 56, *Trichocentrum capistratum* 2n = 28, and *Trichopilia marginata* 2n = 56.

Four different chromosome numbers have been recorded for the section *Miltoniastrum* of the genus *Oncidium*: 2n = 26, 28, 30 and 36. Various chromosome numbers have been reported for *O. carthagenense*, *O. lanceanum*, *O. luridum*, *O. splendidum*, and *O. stramineum*. All utilized species in this section have a single sheathless thick leaf on top of the pseudobulb and a few distichous membraneous bracts subtending the base of the pseudobulb. Species with the chromosome numbers 2n = 26, 28 and 30 have inconspicuous pseudobulbs. *O. microchilum* (Fig. 15 a) and *O. splendidum*, both with 2n = 36, have conspicuous pseudobulbs.

Oncidium jonesianum in the section Teretifolia has 2n = 30 (Fig. 27), the same number was reported earlier for this species by Sinoto (1962). The more recent chromosome number determinations of the species in the section including *O. cebolleta*, *O. nudum* and *O. stipitatum* confirms the number 2n = 36 for these species with the exception of a tetraploid with 2n = 72 (Charanasri et al., 1973). All species of

TABLE IX. CHROMOSOME NUMBERS OF SPECIES UTILIZED IN THIS STUDY

Taxa	Previous Count 2n	Previous Count n	Authority	Present Count 2n	Number of Plants Counted
Genus *Ada*					
A. elegentura	-	-	-	60	2
A. sp.	-	-	-	60	1
Genus Aspasia					
A. epidendroides	-	-	-	60	1
A. principissa	58	-	Sinoto '62	60	1
Genus *Brassia*					
Sect. *Glumaceae*					
B. allenii	50	-	Charanasri *et al.* '73	-	-
Sect. *Brassia*					
B. caudata	60	-	Sinoto '62	60	2
	60		Charanasri *et al.* '73		
B. gireoudiana	60		Sinoto '62	-	-
	60		Charanasri *et al.* '73		
Genus *Comparettia*					
C. falcata	42	-	Sinoto '62	44	1
Genus *Gomesa*					
G. crispa	56	-	Charanasri *et al.* '73	-	-
G. recurva	56	-	Sinoto '62	56	1
Genus *Lockhartia*					
L. micrantha		-		56	1
Genus *Miltonia*					
Sect. *Eumiltonia*					
M. flavescens	56	-	Blumenschein '60	-	-
	60	-	Sinoto '62		
	60	-	Charanasri *et al.* '73		
M. spectabilis	60	-	Sinoto '62	60	2
Sect. *Miltoniopsis*					
M. roezlii 'alba'	56	-	Sinoto '62	56	2

TABLE IX. (Continued) CHROMOSOME NUMBER OF SPECIES UTILIZED IN THIS STUDY

Taxa	Previous Count 2n	Previous Count n	Authority	Present Count 2n	Number of Plants Counted
Genus Odontoglossum					
Sect. Grandia					
O. grande	44	-	Dodson '58	-	-
	60 ?	-	Sinoto '62		
	44	-	Charanasri et al. '73		
Sect. Laevia					
O. stenoglossum	56	-	Charanasri et al. '73	-	-
Sect. Trymenium					
O. citrosmum	44-48	-	Chardard '63	44	1
Sect. Xanthoglossum					
O. cariniferum	56	-	Charanasri et al. '73	-	-
Genus Oncidium					
Sect. Altissima					
O. altissima	56	-	Sinoto '62	-	-
O. ansiferum	56	-	Sinoto '62	-	-
	56	-	Charanasri et al. '73		
O. baueri	52 ca.	-	Dodson '57	56	2
	56	-	Sinoto '62		
	56	-	Charanasri et al. '73		
O. ensatum	56	-	Charanasri et al. '73	-	-
O. floridanum	56	-	Charanasri et al. '73	-	-
O. wentworthianum	56	-	Sinoto '62	56	1
Sect. Barbata					
O. micropogon	-	-	-	56	1
Sect. Concoloria					
O. concolor	-	-	-	-	-
O. onustum	56	-	Sinoto '62	-	-
	56	-	Charanasri et al. '73		

TABLE IX. (Continued) CHROMOSOME NUMBERS OF SPECIES UTILIZED IN THIS STUDY

Taxa	Previous Count 2n	Previous Count n	Authority	Present Count 2n	Number of Plants Counted
Genus Oncidium (continued)					
Sect. Crispa					
O. marshallianum	58	-	Kugust '66	56	-
O. sarcodes	56	-	Dodson '57	-	-
	56	-	Charanasri et al. '73	-	-
Sect. Equitantia					
O. x ann-hadderiae	-	-	-	42	1
O. bahamense	84	-	Sinoto '62	84	2
	84	-	Charanasri et al. '73		
O. calochilum	-	-	-	42	2
O. x cubense	-	-	-	42	1
O. desertorum	40	-	Sinoto '62	40	4
	40	-	Kugust '66		
	40	-	Charanasri et al. '73		
O. x floride-phillepsiae	-	-	-	126	1
O. henekenii	40	-	Sinoto '62	40	1
	40	-	Charanasri et al. '73		
O. jimenezii	-	-	-	42	1
O. leiboldii	42	-	Dodson '58	42	1
	42	-	Sinoto '62		
	40-42	-	Kugust '66		
O. lemonianum	-	-	-	42	1
O. lucayanum	40	-	Sinoto '62	40	1
	40	-	Kugust '66		
	40	-	Charanasri et al. '73		
O. pulchellum	42	-	Dodson '58	-	-
	42	-	Sinoto '62		
	42	-	Kugust '66		
	42	-	Charanasri et al. '73		

TABLE IX. (Continued) CHROMOSOME NUMBERS OF SPECIES UTILIZED IN THIS STUDY

Taxa	Previous Count 2n	Previous Count n	Authority	Present Count 2n	Number of Plants Counted
Genus Oncidium (continued)					
O. quadrilobum	-	-	-	40	1
O. scandens	84	-	Sinoto '62	84	1
O. sylvestre	84	-	Sinoto '62	126	1
O. triquetrum	42	-	Dodson '58	-	-
	42	-	Sinoto '62		
	42	-	Charanasri et al. '73		
O. urophyllum	84	-	Sinoto '62	84	2
O. variegatum	42	-	Dodson '58	42	3
	40	-	Sinoto '62		
	42	-	Charanasri et al. '73		
O. x varvelum	-	-	-	63	1
O. velutinum	-	-	-	84	1
Sect. Glanduligera					
O. liminghii	-	-	-	56	1
O. papilio	38	-	Dodson '57	-	-
	38	-	Sinoto '62		
	38	-	Charanasri et al. '73		
Sect. Miltoniastrum					
O. bicallosum	-	14	Hoffmann '29	28	1
	-	14	Hoffmann '30		
	28	-	Dodson '57		
	28	-	Charanasri et al. '73		
O. carthagenense	28	-	Dodson '57	30	1
	30	-	Sinoto '62		
	30	-	Kugust '66		
	30	-	Charanasri et al. '73		
O. lanceanum	26	13	Sharma & Chatterji '66	26	2
	26	-	Charanasri et al. '73		

TABLE IX. (Continued) CHROMOSOME NUMBERS OF SPECIES UTILIZED IN THIS STUDY

Taxa	Previous Count 2n	Previous Count n	Authority	Present Count 2n	Number of Plants Counted
Genus Oncidium (continued)					
O. lanceanum (continued)					
	28	-	Dodson '57		
	28	-	Sinoto '66		
O. luridum	28	-	Dodson '57	30	2
	28	-	Sharma & Chatterji '66		
	30	-	Charanasri *et al.* '73		
	32	-	Sinoto '62		
	32	-	Kugust '66		
O. microchilum	36	-	Dodson '57	36	2
	36	-	Sinoto '62		
	36	-	Charanasri *et al.* '73		
	37	-	Sinoto '62		
	37	-	Charanasri *et al.* '73		
O. splendidum	34	-	Dodson '57	36	1
	36	-	Sinoto '62		
	36	-	Charanasri *et al.* '73		
O. stramineum	28	-	Sinoto '62	30	1
	30	-	Kugust '66		
	30	-	Charanasri *et al.* '73		
Sect. Oblongata					
O. isthmi	56	-	Sinoto '62	56	1
O. oblongatum	-	-	-	-	-
Sect. Pulvinata					
O. harrisonianum	42	-	Sinoto '62	42	1
O. pulvinatum	42	-	Charanasri *et al.* '73	-	-
Sect. Serpentia					
O. globuliferum	56	-	Sinoto '62	56	1

TABLE IX. (Continued) CHROMOSOME NUMBERS OF SPECIES UTILIZED IN THIS STUDY

Taxa	Previous Count 2n	Previous Count n	Authority	Present Count 2n	Number of Plants Counted
Genus *Oncidium* (continued)					
Sect. *Stellata*					
O. leucochilum	56	-	Dodson '57	56	1
O. maculatum	56	-	Sinoto '62	-	-
	56	-	Charanasri *et al.* '73		
O. nigratum	-	-	-	56	1
Sect. *Synsepala*					
O. flexuosum	56	-	Hoffmann '29	56	1
	56	-	Hoffmann '30		
	56	-	Dodson '57		
Sect. *Teretifolia*					
O. cebolleta	28	-	Dodson '57	-	-
	34	-	Sinoto '62		
	36	-	Blumenschein '60		
	36	-	Charanasri *et al.* '73		
	72	-	Charanasri *et al.* '73		
O. jonesianum	30	-	Kugust '66	30	1
O. nudum	28	-	Dodson '57	-	-
	36	-	Charanasri *et al.* '73		
O. stipitatum	28	-	Dodson '57	-	-
	36	-	Charanasri *et al.* '73		
Sect. *Tigrina*					
O. tigrinum	54	-	Kugust '66	-	-
	56	-	Charanasri *et al.* '73		
Sect. Unclassified					
O. ampliatum	44	-	Dodson '57	44	2
	44	-	Sagawa & Miimoto '61		
	44	-	Sinoto '62		
	44	-	Charanasri *et al.* '73		

TABLE IX. (Continued) CHROMOSOME NUMBERS OF SPECIES UTILIZED IN THIS STUDY

Taxa	Previous Count 2n	Previous Count n	Authority	Present Count 2n	Number of Plants Counted
Genus Ornithophora					
O. radicans	-	-	-	56	1
Genus Rodriguezia					
R. secunda	42	-	Sinoto '62	42	2
R. venusta	42	-	Sinoto '62	-	-
	42	-	Charanasri *et al.* '73		
Genus Trichocentrum					
T. albo-purpureum	24	-	Sinoto '62	24	1
	28	-	Dodson '57		
T. capistratum	-	-	-	28	2
Genus Trichopilia					
T. marginata	-	-	-	56	1

Plate XX. Somatic chromosomes of *Oncidium* species (1,569X) with satellite chromosomes indicated by arrows

Figure:

20. *O. lanceanum*, 2n = 26
21. *O. bicallosum*, 2n = 28
22. *O. stramineum*, 2n = 30
23. *O. luridum*, 2n = 30
24. *O. carthagenense*, 2n = 30
25. *O. microchilum*, 2n = 36
26. *O. splendidum*, 2n = 36
27. *O. jonesianum*, 2n = 30

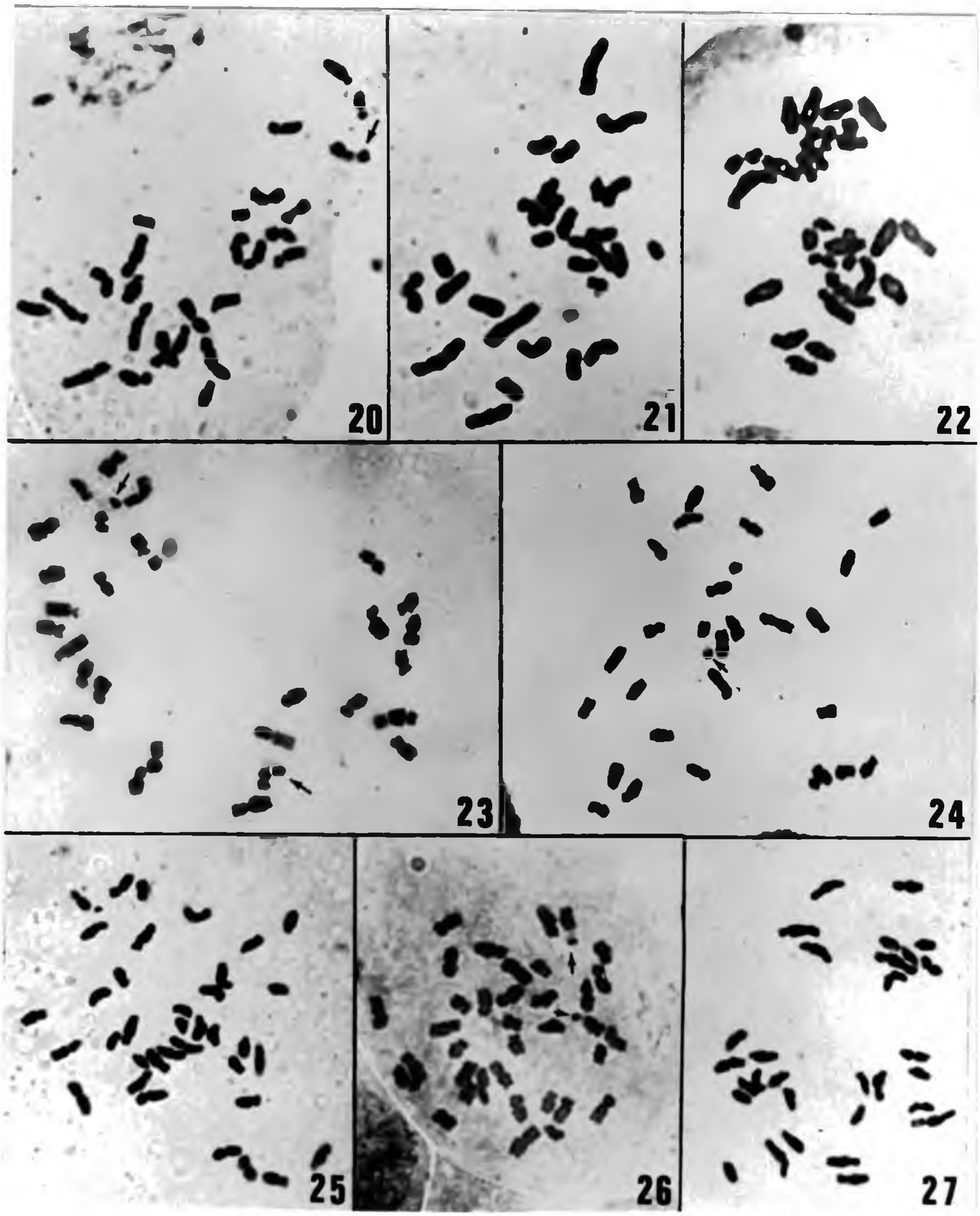

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Plate XXI. Somatic chromosomes of species and natural hybrids in the *Oncidium* alliance (1,569X)

Figure:

28. *Oncidium papilio*, 2n = 38
29. *O. quadrilobum*, 2n = 40
30. *O. x cubense*, 2n = 42
31. *O. x floride-phillepsiae*, 2n = 126
32. *O. sylvestre*, 2n = 126
33. *O. lemonianum*, 2n = 42
34. *O. calochilum*, 2n = 42
35. *O. micropogon*, 2n = 56
36. *O. liminghei*, 2n = 56
37. *O. flexuosum*, 2n = 56
38. *Trichopilia marginata*, 2n = 56
39. *Ornithophora radicans*, 2n = 56
40. *Miltonia spectabilis*, 2n = 60
41. *M. roezlii*, 2n = 56

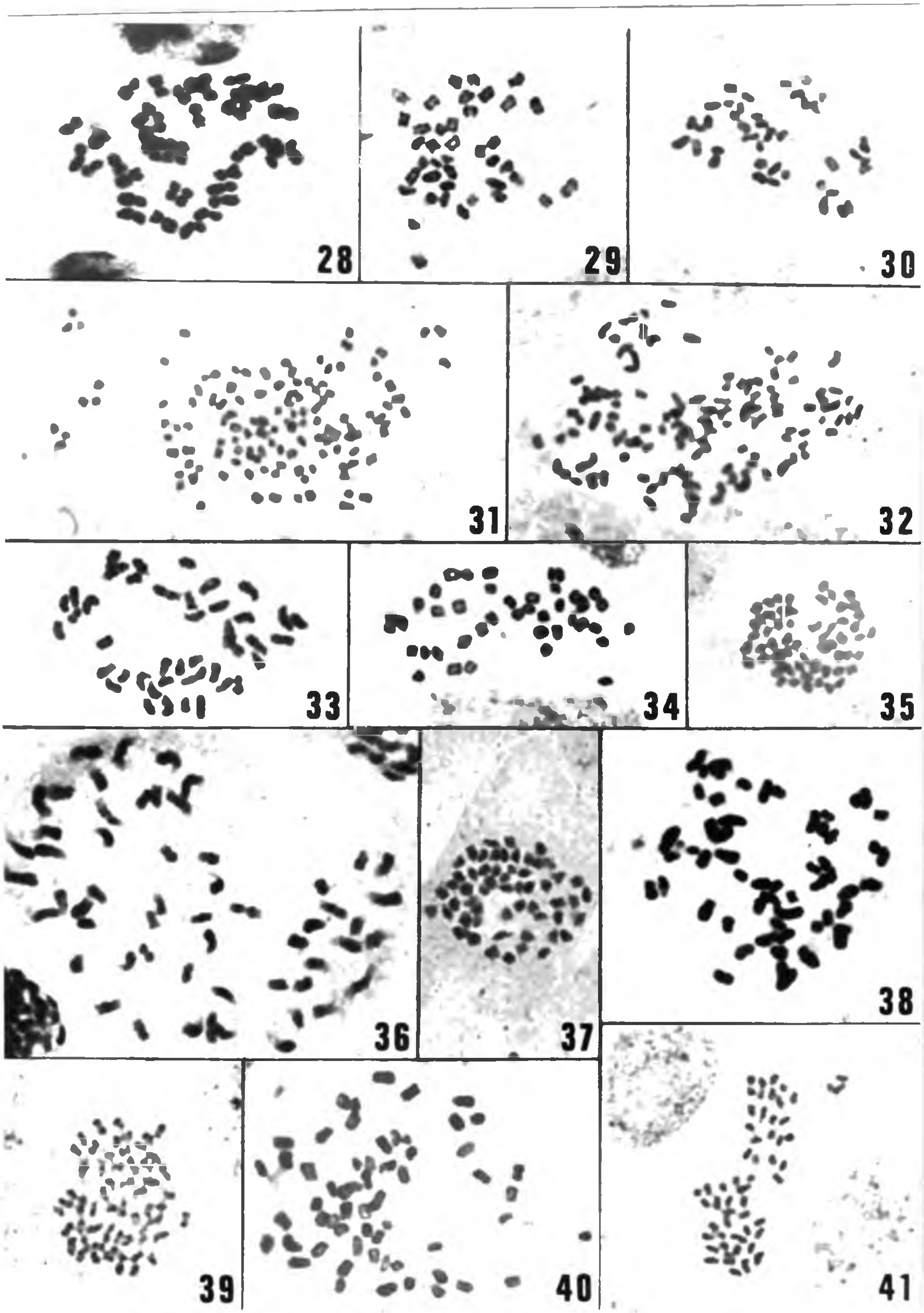
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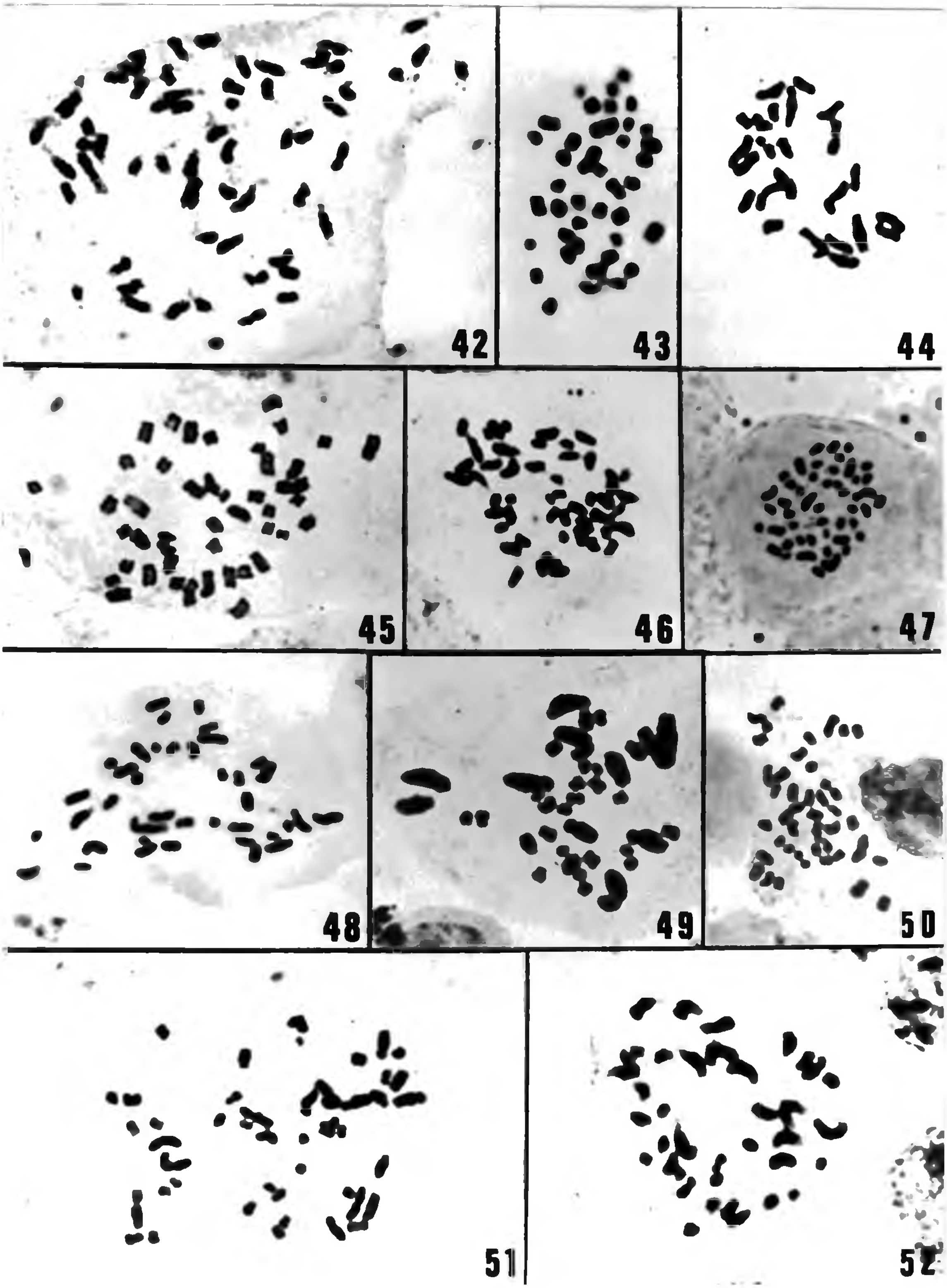
Plate XXII. Somatic chromosomes of species and hybrids in the _Oncidium_ alliance (1,569X)

Figure:

42. _Ada elegentula_, 2n = 60
43. _Odontoglossum citrosmum_, 2n = 44
44. _Trichocentrum albo-purpureum_, 2n = 24
45. _Gomesa crispa_ x _Oncidium cebolleta_, 2n = 46
46. _Oncidium maculatum_ x _Rodriguezia venusta_, 2n = 49
47. _Oncidium pulchellum_ x _O. flexuosum_, 2n = 49
48. _O. triquetrum_ x _O. cebolleta_, 2n = 39
49. _O. pulchellum_ x _O. stramineum_, 2n = 36
50. _O. triquetrum_ x _Comparettia falcata_, 2n = 43
51. _O. microchilum_ x _O. onustum_, 2n = 46
52. _O. pulvinatum_ x _O. microchilum_, 2n = 39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Teretifolia investigated have inconspicuous pseudobulbs, a single sheathless terete leaf on top of the pseudobulb, and a few distichous membraneous bracts subtending the base of the pseudobulb. The only difference that separates Teretifolia from Miltoniastrum is the terete leaf.

The somatic chromosome number 2n = 38 was observed in O. papilio, the type of the section Glanduligera (Fig. 28). O. kramerianum which is closely related to O. papilio also has 2n = 38 (Dodson, 1957). O. liminghei, the only species in the section that has a miniature plant and flowers, had 2n = 56 which is an uncommon number for this group (Fig. 36).

Oncidium sect. Pulvinata has a vegetative appearance similar to that of the section Miltoniastrum. O. harrisonianum in this section was considered to be 2n = 42. A previous count reported for O. pulvinatum, the type species of the section, is also 2n = 42.

In the section Equitantia four chromosome numbers: 2n = 40, 42, 84 and 126 were observed among species and three somatic numbers: 2n = 42, 63 and 126 among the natural hybrids (Figs. 29-34). O. desertorum, O. lucayanum, O. henekenii, and O. quadrilobum, four distinct species, were found to be 2n = 40. O. variegatum, O. leiboldii, and O. x cubense, the natural hybrid between the first two, exhibited exclusively 2n = 42, and have very similar flowers. O. bahamense, O. velutinum and O. scandens were found to be 2n = 84. These also have very similar flowers to those of O. variegatum and may only represent tetraploid forms of O. variegatum. Likewise, O. sylvestre (2n = 126, Fig. 31) may be a hexaploid form of O. variegatum. The chromosome number of O. x varvelum, 2n = 63, is intermediate between the two parental species. O. lemonianum and O.

calochilum, two species with distichous terete leaves, were found to be 2n = 42 (Figs. 33 and 34).

O. ampliatum, a species placed in the section Oblongata by Kranzlin (1922) and Garay (1970) and the section Miltoniastrum by Moir (1972) was found to be 2n = 44, a number which is not found in either of the two sections.

Species in the sections Altissima, Barbata, Concoloria, Crispa, Oblongata, Serpentia and Stellata of the Oncidium genus were found to be exclusively 2n = 56.

The chromosome number of Trichocentrum albo-purpureum was determined to be 2n = 24 (Fig. 44) and T. capistratum, 2n = 28. The vegetative growth of Trichocentrum is very similar to that of the sections Miltoniastrum and Teretifolia and Pulvinata of Oncidium.

Rodriguezia secunda had 2n = 42. Both previous and present counts are in agreement. The same chromosome number was reported for R. venusta (Sinoto, 1962; Charanasri et al., 1973). Rodriguezia has very similar vegetative growth to Oncidium sect. Equitantia, but differs in that it has obvious pseudobulbs, each with a leaf on top.

Odontoglossum citrosmum had 2n = 44 (Fig. 43). Previous reports show that the species in this genus have either 2n = 44 or 2n = 56 (Tanaka and Kamemoto, 1972).

Species in Gomesa, Miltonia sect. Miltoniopsis, and Ornithophora with conspicuous pseudobulbs and thin leathery leaves were found to be 2n = 56 (Fig. 39). One species each of Trichopilia and Lockhartia, two of the most distinct genera in the Oncidium alliance were also found to be 2n = 56. Lockhartia has flattened long slender stems on which are numerous distichous bractlike leaves and it is believed to be distantly related to other genera in the Oncidium alliance. However, its chromosome number is also a multiple of 7 like the majority of the members of the alliance.

Among species in the genera Ada, Aspasia, Brassia section Brassia, and Miltonia section Eumiltonia, the chromosome number 2n = 60 was observed. These are all species with conspicuous pseudobulbs and thin leathery leaves.

In Table X, the chromosome numbers of intra- and intergeneric hybrids in the Oncidium alliance are listed. The chromosome numbers in 80 hybrid individuals from 46 cross combinations are generally the sum of the normally reduced gametic numbers of both parents (Figs. 45-60, Table X). A plant of Oncidium microchilum x O. carthagenense has 2n = 48 which is probably the result of the fertilization of a reduced egg of O. microchilum (n=18) by an unreduced pollen of O. carthagenense (n=30). One plant each of the crosses O. pulchellum (2n=42) x O. variegatum (2n=42) and O. cebolleta (2n=36) x O. cebolleta (2n=72) have 2n=84 and 108 (Fig. 57) respectively. Both plants probably resulted from spontaneous chromosome doubling of the F_1 hybrids during the embryonic or young seedling stages. No hybrids with aneuploid chromosome number deviation from the expected numbers were detected in the present investigation.

TABLE X. SOMATIC CHROMOSOME NUMBERS OF HYBRIDS IN THE ONCIDIUM ALLIANCE WITH CHROMOSOME NUMBERS OF THE PARENTAL PLANTS IN PARENTHESIS

Hybrid	No. of Plants Sampled	Chromosome Counts (2n)
Comparettia x Oncidium section Equitantia*		
Oncidium triquetrum (2n = 42) x Comparettia falcata (2n = 44)	1	43
Odontoglossum x Oncidium section Teretifolia		
Odm. stenoglossum (2n = 56) x Onc. nudum (2n = 36)	1	46
Odontoglossum x Oncidium section Stellata		
Odm. stenoglossum (2n = 56) x Onc. maculatum (2n = 56)	1	56
Oncidium		
Section Altissima x Section Crispa		
O. altissima x O. sarcodes 1/	1	56
Section Altissima x Section Equitantia*		
O. triquetrum (2n = 42) x O. floridanum (2n = 56)	3	49
Section Altissima x Section Miltoniastrum*		
O. microchilum (2n = 36) x O. floridanum (2n = 56)	1	46
Section Altissima x Section Stellata		
O. floridanum (2n = 56) x O. maculatum (2n = 56)	2	56
Section Altissima x O. ampliatum*		
O. ampliatum (2n = 44) x O. ansiferum (2n = 56)	1	50
Section Concoloria x Section Miltoniastrum*		
O. microchilum (2n = 36) x O. onustum (2n = 56)	1	46
Section Equitantia		
O. pulchellum (2n = 42) x O. triquetrum (2n = 42)	1	42
O. pulchellum (2n = 42) x O. variegatum (2n = 42)	2	42, 84
O. triquetrum (2n = 42) x O. variegatum (2n = 42)	2	42
O. pulchellum (2n = 42) x O. lucayanum (2n = 40)	1	41
O. triquetrum (2n = 42) x O. lucayanum (2n = 40)	1	41
O. triquetrum (2n = 42) x O. desertorum (2n = 40)	3	41

* reciprocal combination is included

1/ hybrid previously available and chromosome numbers of the parental plants are not known

TABLE X. (Continued) SOMATIC CHROMOSOME NUMBERS OF HYBRIDS IN THE *ONCIDIUM* ALLIANCE WITH CHROMOSOME NUMBERS OF THE PARENTAL PLANTS IN PARENTHESIS

Hybrids	No. of Plants Sampled	Chromosome Counts (2n)
Oncidium (continued)		
Section *Equitantia* x Section *Miltoniastrum*		
O. pulchellum (2n = 42) x *O. stramineum* (2n = 30)	1	36
Section *Equitantia* x Section *Synsepala*		
O. pulchellum (2n = 42) x *O. flexuosum* (2n = 56)	2	49
Section Equitantia x Section Teretifolia		
O. triquetrum (2n = 42) x *O. cebolleta* (2n = 36)	2	39
Section *Miltoniastrum*		
O. carthagenense (2n = 30) x *O. splendidum* (2n = 36)	1	33
O. carthagenense (2n = 30) x *O. stramineum* (2n = 30)	1	30
O. stramineum (2n = 30) x *O. carthagenense* (2n = 30)	2	30
O. carthagenense (2n = 30) x *O. luridum* (2n = 30)	2	30
O. stramineum (2n = 30) x *O. luridum* (2n = 30)	3	30
O. microchilum (2n = 36) x *O. bicallosum* (2n = 28)	3	32
O. microchilum (2n = 36) x *O. carthagenense* (2n = 30)	2	33
O. microchilum (2n = 36) x *O. luridum* (2n = 30)	1	33
O. microchilum (2n = 36) x *O. splendidum* (2n = 36)	5	36
O. lanceanum (2n = 26) x *O. luridum* (2n = 30)	1	28
O. luridum x *O. lanceanum* 1/	2	28
O. splendidum x *O. lanceanum* 1/	1	31
Section *Miltoniastrum* x Section *Pulvinata**		
O. pulvinata (2n = 42) x *O. microchilum* (2n = 36)	1	39
Section *Miltoniastrum* x Section *Teretifolia**		
O. luridum (2n = 30) x *O. cebolleta* (2n = 36)	2	33
O. luridum (2n = 30) x *O. nudum* (2n = 36)	1	33
O. microchilum (2n = 36) x *O. nudum* (2n = 36)	1	36
O. nudum (2n = 36) x *O. carthagenense* (2n = 30)	1	33
O. splendidum (2n = 36) x *O. nudum* (2n = 36)	5	36
O. splendidum (2n = 36) x *O. stipitatum* (2n = 36)	4	36

* reciprocal combination is included
1/ hybrid previously available and chromosoms numbers of the parental plants are not known

TABLE X. (Continued) SOMATIC CHROMOSOME NUMBERS OF HYBRIDS IN THE *ONCIDIUM* ALLIANCE WITH CHROMOSOME NUMBERS OF THE PARENTAL PLANTS IN PARENTHESIS

Hybrid	No. of Plants Sampled	Chromosome Counts (2n)
Oncidium (continued)		
Section *Miltoniastrum* x *O. ampliatum**		
O. ampliatum (2n = 44) x *O. luridum* (2n = 30)	3	37
O. ampliatum (2n = 44) x *O. stramineum* (2n = 30)	1	37
Section *Teretifolia*		
O. cebolleta (2n = 36) x *O. cebolleta* (2n = 72)	2	54, 108
O. cebolleta (2n = 36) x *O. nudum* (2n = 36)	2	36
O. cebolleta (2n = 36) x *O. stipitatum* (2n = 36)	2	36
O. stipitatum (2n = 36) x *O. nudum* (2n = 36)	1	36
Section *Teretifolia* x *O. ampliatum*		
O. nudum (2n = 36) x *O. ampliatum* (2n = 44)	1	40
Oncidium section *Stellata* x *Rodriguezia*		
O. maculatum (2n = 56) x *R. venusta* (2n = 42)	1	49
Oncidium section *Miltoniastrum* x *Trichocentrum**		
T. albo-purpureum x *O. lanceanum*1/	1	25

* reciprocal combination is included

1/ hybrid previously available and chromosome numbers of the parental plants are not known

Plate XXIII. Somatic chromosomes of Oncidium hybrids (1,569X)

Figure:

53. O. lanceanum x O. luridum, 2n = 28

54. O. carthagenense x O. stramineum, 2n = 30

55. O. microchilum x O. bicallosum, 2n = 32

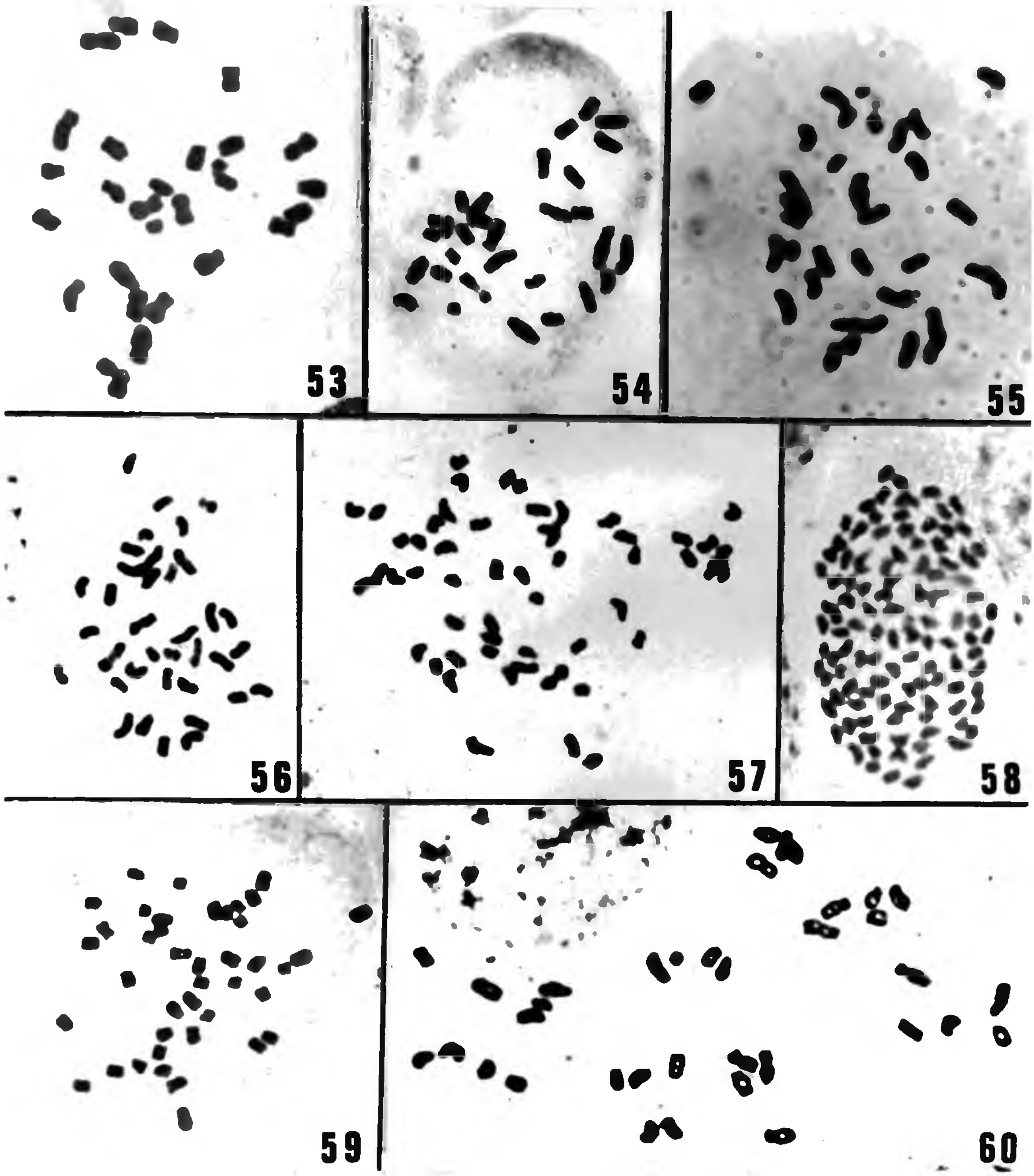
56. O. cebolleta x O. stipitatum, 2n = 36

57. O. cebolleta 2N x O. cebolleta 4N, 2n = 54

58. O. cebolleta 2N x O. cebolleta 4N, 2n = 108

59. O. triquetrum x O. lucayanum, 2n = 41

60. O. splendidum x O. stipitatum, 2n = 36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60

Karyotypes

Table XI shows the results of the analysis of karyotypes of 11 species. Variations in size of chromosomes exist among species. The morphology of the chromosomes, based on the centromeric positions, also seems to provide valid differences among species (Figs. 58-68).

Trichocentrum albo-purpureum, Oncidium lanceanum (Figs. 20 and 59), O. bicallosum (Figs. 21 and 60), O. luridum (Figs. 6, 23 and 63), O. carthagenense (Figs. 15 A, 24 and 64) and O. stramineum (Figs. 22 and 62) are species with thick and fleshy leaves and inconspicuous pseudobulbs. The karyotypes of all these species except O. stramineum are similar in mean F% (Table XI). The karyotype of O. stramineum (Fig. 62) is distinguishable from those of O. carthagenense (Fig. 64) and O. luridum (Fig. 63), the other two 30 chromosome species, by the much smaller mean F% and a large number of chromosomes with subterminal centromeres.

O. lanceanum, O. bicallosum, O. luridum, O. carthagenense, and O. stramineum have a similar pair of medium sized chromosomes with exceptionally large and distinct satellites (Figs. 59-62). The similarity of the satellite chromosomes of these 5 species of the section Miltoniastrum in the genus Oncidium gives further evidence of their close relationship.

Oncidium jonesianum, a species in the section Teretifolia, has a growth habit very similar to that of the Miltoniastrum section, but its leaves are terete. The mean chromosome length and mean F% of this species is very close to that of the other 30 chromosome species, O. stramineum, of the section Miltoniastrum. However, its karyotype does not exhibit the large satellites that characterize the karyotypes of the species with 2n = 26 to 30 in th4 section Miltoniastrum (Figs. 27 and 61).

Oncidium splendidum and O, microchilum, two species with thick flat leaves and conspicuous pseudobulbs, are believed to belong to the section Miltoniastrum (Moir, 1973). O. microchilum, the species with obsolete mid-lobe of the labellum shows a low average F%, and a large number of chromosomes with subterminal centromere (Table XI, Fig. 66). There is an apparent similarity between the karyotypes of O. splendidum and O. microchilum in that both have a pair of small chromosomes with satellites on the long arms, and they both have 2n = 36 (Figs. 65 and 66).

O. papilio in the section Glanduligera has 38 chromosomes. Its karyotype is distinguishable by the high mean F%, 41.7 and the absence of the subterminal chromosome (Table XI, Fig. 67). O. ampliatum, a species believed to be closely related to O. papilio (Dodson, 1958), also exhibited a relatively high mean F% of 43.0 (Table XI, Fig. 68). Both karyotypes are symmetrical.

TABLE XI. KARYOTYPE ANALYSIS OF 11 SPECIES OF ONCIDIUM AND TRICHOCENTRUM

Species	Cell sample	Chromosome length[1/] mean	Range	Number of Chromosome[2/] Total	ST	SM	M	Mean F%
Trichocentrum albopurpureum	1	38.4	53-21	24	3	17	4	38.3
	2	35.6	62-20	24	5	16	3	36.6
Oncidium lanceanum	1	37.2	55-20	26	11	11	4	32.0
	2	37.0	66-20	26	13	9	4	32.9
	3	34.4	48-20	26	8	11	7	34.5
O. bicallosum	1	38.4	67-21	28	7	15	6	37.2
O. luridum	1	27.6	39-14	30	3	24	3	36.5
	2	31.6	49-21	30	3	21	6	38.6
O. carthagenense	1	25.6	37-14	30	7	13	10	35.2
	2	24.0	38-14	30	6	20	4	37.7
O. stramineum	1	35.2	65-18	30	18	9	3	29.7
	2	36.2	63-19	30	19	5	6	29.3
O. jonesianum	1	32.0	48-22	30	15	9	6	28.3
	2	32.2	51-22	30	17	8	5	29.7
O. splendidum	1	31.9	42-23	36	5	24	7	37.3
	2	35.7	52-25	36	2	28	6	37.4
O. microchilum	1	31.7	43-22	36	19	16	1	29.9
	2	29.6	41-22	36	21	12	3	31.1
O. papilio	1	31.2	37-23	38	0	29	9	41.7
O. ampliatum	1	42.8	58-22	44	2	23	19	42.8
	2	39.4	49-23	44	1	26	17	43.2

1/ Expressed as millimeters of chromosomes magnified at 11,000X

2/ ST is subterminal (0-30.0 F%); SM is submedian (30.1-45.0 F%); M is median (45.1-50.0 F%)

Plate XXIV. Karyotypes of *Oncidium* and *Trichocentrum* species (4,125X)

Figure:

61. *T. albo-purpureum*

62. *O. lanceanum*

63. *O. bicallosum*

64. *O. jonesianum*

61


62

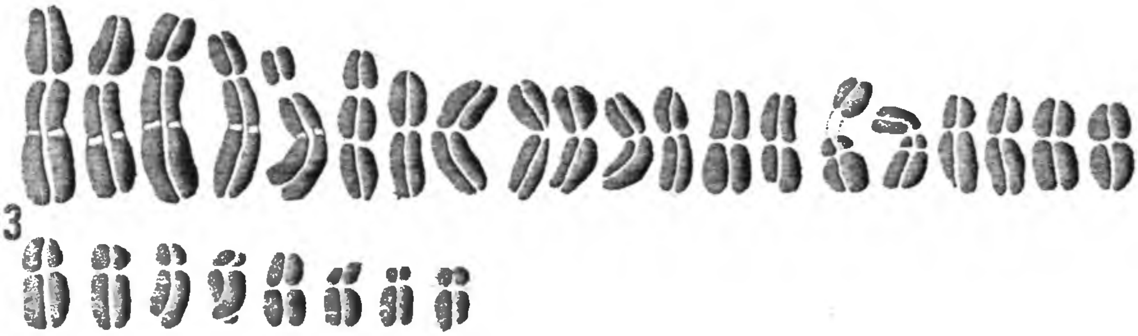

63


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Plate XXV. Karyotypes of *Oncidium* species (4,125X)

Figure:

65. *O. stramineum*

66. *O. luridum*

67. *O. carthagenense*

68. *O. splendidum*


65


66


67


68

Plate XXVI. Karyotypes of *Oncidium* species (4,125X)

Figure:

69. *O. microchilum*

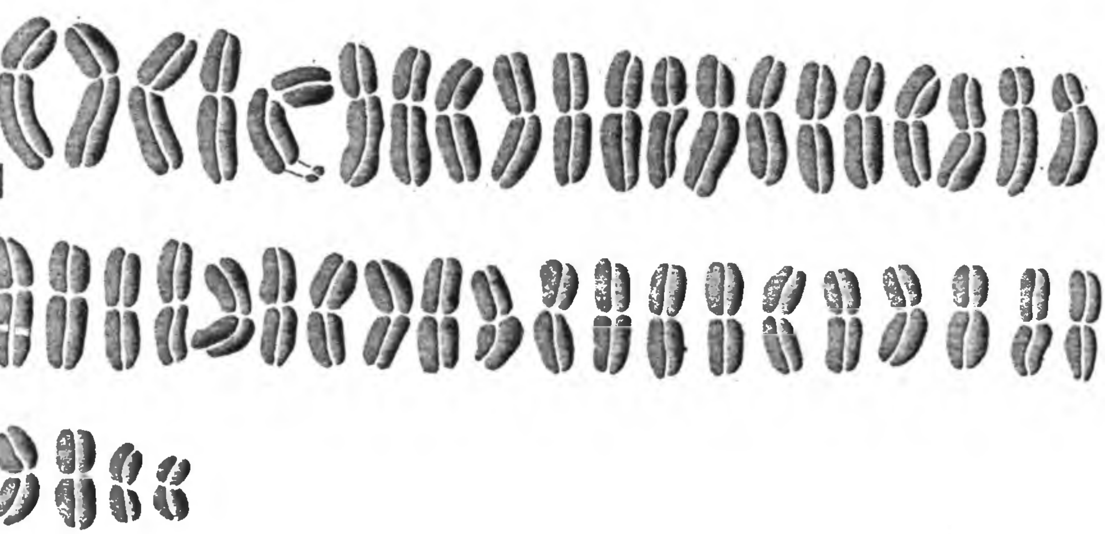
70. *O. papilio*

71. *O. ampliatum*

69

70

71



Meiosis, Sporad Formation, and Fertility of Species Hybrids

Observations on meiosis and sporad formation in 31 *Odontocidium*, *Oncidium* and *Trichonidium* primary hybrids are shown in Table XII and Table XIII. Results of compatible self- and sib-pollinations in 14 hybrids, back crossing of 5 hybrids, and interspecific hybridization between a triploid hybrid of *O. cebolleta* with *O. nudum* are given in Table XIV.

On the basis of chromosome homology the species within each of the sections *Equitantia*, *Teretifolia* and *Miltoniastrum* appear to be closely related. The homoploid intrasectional F_1 hybrids were generally fertile, while the hybrids involving parents with different chromosome numbers were either partially or highly sterile.

In the section *Equitantia* the hybrids among the 42 chromosome species exhibited normal meiosis, regular sporad formation and predominately high fertility (Tables XII, XIII, XIV, Fig. 72). The hybrids between 42 and 40 chromosome species, on the other hand, exhibited 20 bivalents + 1 univalent or 19 bivalents + 1 trivalent (Table XII, Figs. 73-75). The sporads were mostly tetrads, but those with aberrant numbers of cells were also seen (Table XIII). Sib crosses among F_1 of *O. triquetrum* x *O. lucayanum* gave few fertile seeds. However, the back cross (*O. triquetrum* x *O. desertorum*) x *O. desertorum* gave a relatively high percent of viable seeds (Table XIV).

The hybrids between species with 36 chromosomes in the section *Teretifolia* exhibited uniformly 18 bivalents, normal tetrads and highly fertile F_1 hybrids. The fertility of the hybrids with 36 chromosome was as good as that of the parental species (Tables II, XIV, Figs. 76-78).

TABLE XII. MEAN CHROMOSOME CONFIGURATIONS AT METAPHASE I OF MEIOSIS OF ONCIDIUM, ODONTOCIDIUM AND TRICHONIDIUM HYBRIDS

Hybrid	Plant Sample	Chromosome No. (2n)	Mean Configuration Per PMC	Number of PMCs Observed
Odontoglossum x Oncidium sect. Stellata				
Odm. stenoglossum x Onc. maculatum	1	56	28.0 II	25
Oncidium				
Sect. Altissima x Sect. Crispa				
O. altissimum x O. sarcodes 1/	1	56	27.5 II + 1.0 I	25
Sect. Altissima x Sect. Equitantia*				
O. triquetrum x O. floridanum	1	49	14.4 II + 20.2 I	10
Sect. Altissima x Sect. Miltoniastrum*				
O. microchilum x O. floridanum	1	46	9.3 II + 27.5 I	8
Sect. Altissima x Sect. Pulvinata*				
O. pulvinatum x O. floridanum	1	49	6.8 II + 35.4 I	17
Sect. Altissima x Sect. Stellata				
O. floridanum x O. maculatum	1	56	28.0 II	25
	2	56	28.0 II	25
Sect. Equitantia				
O. pulchellum x O. triquetrum	1	42	20.95 II + 0.1 I	25
O. triquetrum x O. variegatum	1	42	20.9 II + 0.2 I	20
	2	42	20.95 II + 0.1 I	25
O. pulchellum x O. lucayanum	1	41	20.0 II + 1.0 I	25
O. triquetrum x O. desertorum	1	41	0.1 III + 19.8 II + 1.2 I	10
	2	41	20.0 II + 1.0 I	10
	3	41	20.0 II + 1.0 I	10
O. triquetrum x O. lucayanum	1	41	19.95 II + 1.1 I	25
Sect. Miltoniastrum				
O. carthagenense x O. stramineum	1	30	15.0 II	25
O. stramineum x O. carthagenense	1	30	15.0 II	25
	2	30	15.0 II	25

* reciprocal combination is included

1/ hybrid previously available

TABLE XII. (Continued) MEAN CHROMOSOME CONFIGURATIONS AT METAPHASE I OF MEIOSIS OF *ONCIDIUM*, *ODONTOCIDIUM* AND *TRICHONIDIUM* HYBRIDS

Hybrid	Plant Sample	Chromosome No. (2n)	Mean Configuration Per PMC	Number of PMCs Observed
Oncidium (continued)				
Sect. *Miltoniastrum* (continued)				
O. carthagenense x *O. luridum*	1	30	15.0 II	25
	2	30	15.0 II	25
O. stramineum x *O. luridum*	1	30	15.0 II	25
	2	30	15.0 II	25
	3	30	15.0 II	25
O. luridum x *O. lanceanum* 1/	1	28	0.4 III + 12.4 II + 1.8 I	18
	2	28	0.4 III + 12.6 II + 1.6 I	16
O. splendidum x *O. lanceanum* 1/	1	31	0.4 III + 12.5 II + 4.8 I	11
O. microchilum x *O. carthagenense*	1	33	0.3 III + 14.7 II + 2.7 I	7
	2	33	0.7 III + 14.3 II + 2.3 I	12
O. microchilum x *O. luridum*	1	33	0.4 III + 14.6 II + 2.7 I	16
Sect. *Miltoniastrum* x Sect. *Pulvinata**				
O. pulvinatum x *O. microchilum*	1	39	13.2 II + 12.6 I	18
Sect. *Miltoniastrum* x Sect. *Teretifolia**				
O. luridum x *O. cebolleta*	1	33	15.0 II + 3.0 I	10
	2	33	0.1 III + 14.9 II + 2.9 I	15
O. luridum x *O. nudum*	1	33	15.0 II + 3.0 I	7
O. nudum x *O. carthagenense*	1	33	0.5 III + 14.5 II + 2.5 I	11
O. microchilum x *O. nudum*	1	36	16.9 II + 2.2 I	25
O. splendidum x *O. nudum*	1	36	17.95 II + 0.1 I	25
Sect. *Miltoniastrum* x *O. ampliatum**				
O. ampliatum x *O. luridum*	1	37	2.4 II + 32.2 I	12
	2	37	2.8 II + 31.4 I	11

* reciprocal combination is included

1/ hybrid previously available

TABLE XII. (Continued) MEAN CHROMOSOME CONFIGURATIONS AT METAPHASE I OF MEIOSIS OF ONCIDIUM, ODONTOCIDIUM AND TRICHONIDIUM HYBRIDS

Hybrid	Plant Sample	Chromosome No. (2n)	Mean Configuration Per PMC	Number of PMCs Observed
Oncidium (continued)				
Sect. Miltoniastrum x O. ampliatum* (continued)				
O. ampliatum x O. stramineum	1	37	1.3 II + 34.4 I	7
Sect. Teretifolia				
O. cebolleta x O. nudum	1	36	18.0 II	25
	2	36	18.0 II	25
O. cebolleta x O. stipitatum	1	36	18.0 II	25
	2	36	18.0 II	25
O. stipitatum x O. nudum	1	36	18.0 II	25
Oncidium sect. Miltoniastrum x Trichocentrum*				
T. albo-purpureum x O. lanceanum	1	25	7.8 II + 9.3 I	36

* reciprocal combination is included
1/ hybrid previously available

TABLE XIII. SPORAD FORMATION IN ODONTOCIDIUM, ONCIDIUM, AND TRICHONIDIUM HYBRIDS

Hybrid	Plant Sample	Sporad					Total
		Tetrad	Tetrad + mcs*	Dyad	Dyad + mcs	Others	
Odontoglossum x Oncidium sect. Stellata							
Odm. stenoglossum x Onc. maculatum	1	200	-	-	-	-	200
Oncidium							
Sect. Altissima x Sect. Crispa							
O. altissimum x O. sarcodes 1/	1	179	20	1	-	-	200
Sect. Altissima x Sect. Equitantia*							
O. triquetrum x O. floridanum	1	69	106	8	16	1	200
Sect. Altissima x Sect. Miltoniastrum*							
O. microchilum x O. floridanum	1	40	22	60	14	2	138
Sect. Altissima x Sect. Pulvinata*							
O. pulvinatum x O. floridanum	1	114	5	62	8	11	200
Sect. Altissima x Sect. Stellata							
O. floridanum x O. maculatum	1	200	-	-	-	-	200
	2	200	-	-	-	-	200
	3	200	-	-	-	-	200
Sect. Equitantia							
O. pulchellum x O. triquetrum	1	200	-	-	-	-	200
O. triquetrum x O. variegatum	1	200	-	-	-	-	200
	2	200	-	-	-	-	200
O. pulchellum x O. lucayanum	1	197	2	1	-	-	200
O. triquetrum x O. desertorum	1	199	-	-	-	1	200
	2	196	-	4	-	-	200
O. triquetrum x O. lucayanum	1	186	14	-	-	-	200
	2	199	1	-	-	-	200

* reciprocal combination is included
1/ hybrid previously available

TABLE XIII. (Continued) SPORAD FORMATION IN *ODONTOCIDIUM*, *ONCIDIUM*, AND *TRICHONIDIUM* HYBRIDS

Hybrid	Plant Sample	Sporad					Total
		Tetrad	Tetrad + mcs*	Dyad	Dyad + mcs	Others	
Sect. *Miltoniastrum*							
O. carthagenense x *O. stramineum*	1	200	-	-	-	-	200
O. stramineum x *O. carthagenense*	1	200	-	-	-	-	200
	2	200	-	-	-	-	200
O. carthagenense x *O. luridum*	1	200	-	-	-	-	200
O. stramineum x *O. luridum*	1	200	-	-	-	-	200
	2	200	-	-	-	-	200
O. luridum x *O. lanceanum* 1/	1	190	7	2	-	1	200
O. splendidum x *O. lanceanum* 1/	1	125	54	5	8	8	200
O. microchilum x *O. carthagenense*	1	186	1	9	1	3	200
O. microchilum x *O. luridum*	1	190	3	7	-	-	200
Sect. *Miltoniastrum* x Sect. *Pulvinata**							
O. pulvinatum x *O. microchilum*	1	28	2	36	5	29	100
Sect. *Miltoniastrum* x Sect. *Teretifolia**							
O. luridum x *O. cebolleta*	1	193	1	6	-	-	200
O. luridum x *O. nudum*	1	127	2	61	1	10	200
O. nudum x *O. carthagenense*	1	71	1	25	2	1	100
O. microchilum x *O. nudum*	1	105	1	71	2	21	200
O. splendidum x *O. nudum*	1	189	5	6	-	-	200
Sect. *Miltoniastrum* x *O. ampliatum**							
O. ampliatum x *O. luridum*	1	61	27	6	2	4	100
	2	180	4	10	2	4	200
O. ampliatum x *O. stramineum*	1	4	-	190	1	5	200
Sect. *Teretifolia*							
O. cebolleta x *O. nudum*	1	200	-	-	-	-	200
O. cebolleta x *O. stipitatum*	1	200	-	-	-	-	200
O. stipitatum x *O. nudum*	1	200	-	-	-	-	200

* reciprocal combination is included
1/ hybrid previously available

TABLE XIII. (Continued) SPORAD FORMATION IN ODONTOCIDIUM, ONCIDIUM, AND TRICHONIDIUM HYBRIDS

Hybrid	Plant Sample	Sporad					Total
		Tetrad	Tetrad + mcs*	Dyad	Dyad +mcs	Others	
Sect. Teretifolia (continued)							
O. cebolleta 4N x O. nudum	1	22	8	162	5	3	200
Oncidium sect. Miltoniastrum x Trichocentrum*							
T. albo-purpureum x O. lanceanum	1	158	35	2	-	5	200

* reciprocal combination is included
1/ hybrid previously available

TABLE XIV. RESULTS OF SELF-, SIB-, BACK CROSS-, AND CROSS-POLLINATIONS IN *ONCIDIUM* HYBRIDS

Cross		Type of Mating	No. of Pollination	Fruit Set No.	%	Percent Apparent Viable Seed
Sect. *Altissima* x Sect. *Stellata*						
(*O. floridanum* x *O. maculatum*)	Pl.[1]1 x Pl.2	sib	2	2	100	71.5
	Pl.2 x Pl.1	sib	2	2	100	72.0
Sect. *Equitantia*						
(*O. pulchellum* x *O. triquetrum*)	Pl.1 x Pl.2	sib	2	2	100	81.5
	Pl.2 x Pl.1	sib	2	2	100	93.0
	Pl.3 x Pl.2	sib	2	2	100	92.0
(*O. pulchellum* x *O. variegatum*)	Pl.1 x Pl.2	sib	2	2	100	53.0
	Pl.2 x Pl.3	sib	2	2	100	57.0
(*O. triquetrum* x *O. variegatum*)	Pl.1 x Pl.2	sib	2	2	100	29.0
	Pl.3 x Pl.2	sib	2	2	100	40.0
	Pl.2 x Pl.4	sib	2	2	100	64.5
(*O. triquetrum* x *O. desertorum*)	x *O. desertorum*	back cross	2	2	100	67.5
(*O. triquetrum* x *O. lucayanum*)	Pl.1 x Pl.2	sib	2	2	100	1.0
Sect. *Miltoniastrum*						
(*O. carthagenense* x *O. luridum*)	Pl.1 selfed	self	2	2	100	48.5
	Pl.2 x Pl.1	sib	2	2	100	53.0
	Pl.2 x Pl.4	sib	2	1	50	28.0
	Pl.2 x Pl.7	sib	2	2	100	72.5
	Pl.3 selfed	self	2	2	100	27.5
	Pl.3 x Pl.7	sib	2	2	100	48.0
	Pl.5 x Pl.6	sib	2	2	100	81.5
(*O. carthagenense* x *O. stramineum*)	Pl.1 x Pl.2	sib	2	2	100	84.0
(*O. stramineum* x *O. luridum*)	Pl.1 selfed	self	2	2	100	53.5
	Pl.1 x Pl.2	sib	2	2	100	87.5
	Pl.2 selfed	self	2	2	100	31.5

1/ Pl. refers to plant number

TABLE XIV. (Continued) RESULTS OF SELF-, SIB-, BACK CROSS-, AND CROSS-POLLINATIONS IN *ONCIDIUM* HYBRIDS

Cross	Type of Mating	No. of Pollination	Fruit Set No.	%	Percent Apparent Viable Seed
Sect. *Miltoniastrum* x Sect. *Teretifolia**					
(*O. luridum* x *O. nudum*) Pl.1 x Pl.2	sib	2	2	100	8.5
(*O. nudum* x *O. carthagenense*) Pl.1 x Pl.2	sib	4	4	100	0.25
(*O. microchilum* x *O. nudum*) Pl.1 x Pl.2	sib	2	1	50	0(v) 2/
(*O. splendidum* x *O. nudum*) x *O. nudum*	back cross	2	2	100	1.5
Sect. *Teretifolia*					
(*O. nudum* x *O. cebolleta*) x (*O. cebolleta* x *O. nudum*)	sib	2	2	100	92.5
(*O. cebolleta* x *O. nudum*) Pl.1 x Pl.2	sib	2	2	100	86.0
Pl.3 x Pl.1	sib	2	2	100	98.5
Pl.4 x Pl.5	sib	2	2	100	83.0
(*O. cebolleta* x *O. nudum*)x(*O. nudum* x *O. cebolleta*)	half-sib	2	2	100	98.5
(*O. cebolleta* x *O. nudum*) x *O. nudum* x *O. cebolleta*)	half-sib	2	2	100	97.5
(*O. cebolleta* x *O. nudum*) x *O. nudum*	back-cross	2	2	100	99.5
(*O. nudum* x *O. cebolleta*) x *O. nudum*	back cross	2	2	100	99.0
(*O. cebolleta* 2N x *O. cebolleta* 4N) x *O. nudum*	out cross	2	2	100	0.5
(*O. nudum* x *O. cebolleta* 4N) x *O. nudum*	back cross	2	2	100	0(v)
(*O. nudum* x *O. cebolleta* 4N) x *O. cebolleta* 2N	back cross	2	2	100	0.5
(*O. cebolleta* x *O. stipitatum*) Pl.1 x Pl.2	sib	2	2	100	77.0

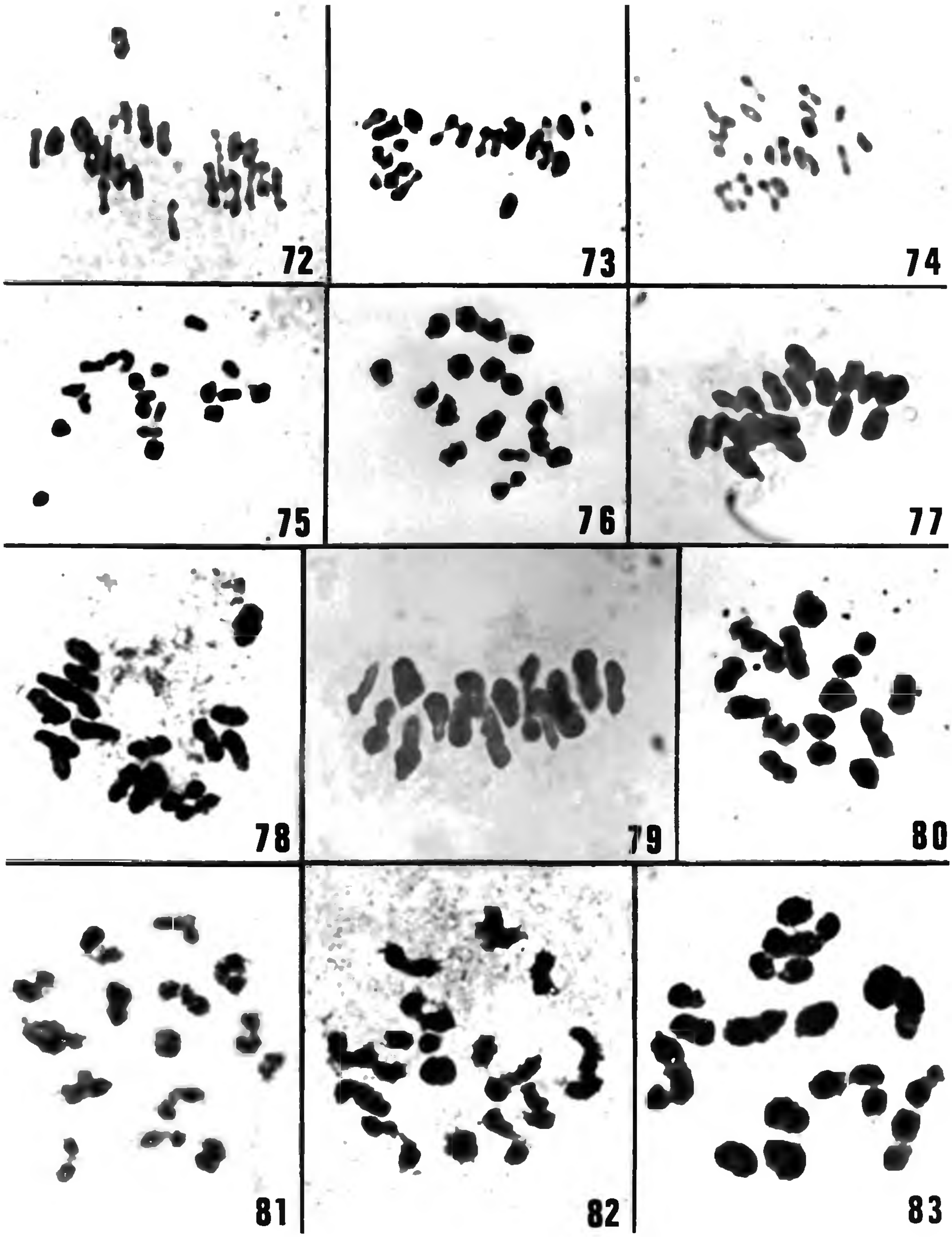
* reciprocal combination is included

2/ (v) following 0 indicates that some seedlings were germinated

Plate XXVII. Metaphase I and diakinasis configurations of primary *Oncidium* hybrids (1,569X)

Figure:

72. *O. triquetrum* x *O. variegatum*, 21 II
73. *O. triquetrum* x *O. desertorum*, 20 II + 1 I
74. *O. pulchellum* x *O. lucayanum*, 20 II + 1 I
75. *O. triquetrum* x *O. lucayanum*, 20 II + 1 I
76. *O. cebolleta* x *O. nudum*, 18 II
77. *O. nudum* x *O. stipitatum*, 18 II
78. *O. cebolleta* x *O. stipitatum*, 18 II
79. *O. stramineum* x *O. luridum*, 15 II
80. *O. carthagenense* x *O. luridum*, 15 II
81. *O. carthagenense* x *O. stramineum*, 15 II
82. *O. microchilum* x *O. luridum*, 15 II + 3 I
83. *O. microchilum* x *O. carthagenense*, 1 III + 14 II + 2 I


72
73
74
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81
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83

The hybrids between the tetraploid form of O. cebolleta and both its diploid counterparts showed highly irregular sporads and high sterility (Tables XIII, XIV).

The section Miltoniastrum has the most diverse aneuploid variation. However, the chromosome homology was generally good in spite of the difference in chromosome numbers of the parental species in several hybrids. The hybrids among O. carthagenense, O. luridum and O. stramineum with 2n = 30, exhibited uniformly 15 bivalents (Tables XII, Figs. 79-81). The hybrids between species with different chromosome numbers appeared to have all the chromosomes from the low chromosome number parents paired with their counterparts from the other parents, and the extra chromosomes from the high chromosome number parents unpaired or involved in multivalent associations (Table XII, Figs. 82-85).

Sporad formation of the hybrids within the 30 chromosome species was uniformly regular in tetrads. Sporads of the hybrids involving species with different chromosome numbers, on the contrary, reflected the irregularity at Metaphase I. Normal tetrads and sporads having aberrant numbers of cells with or without microcytes were seen (Table XIII).

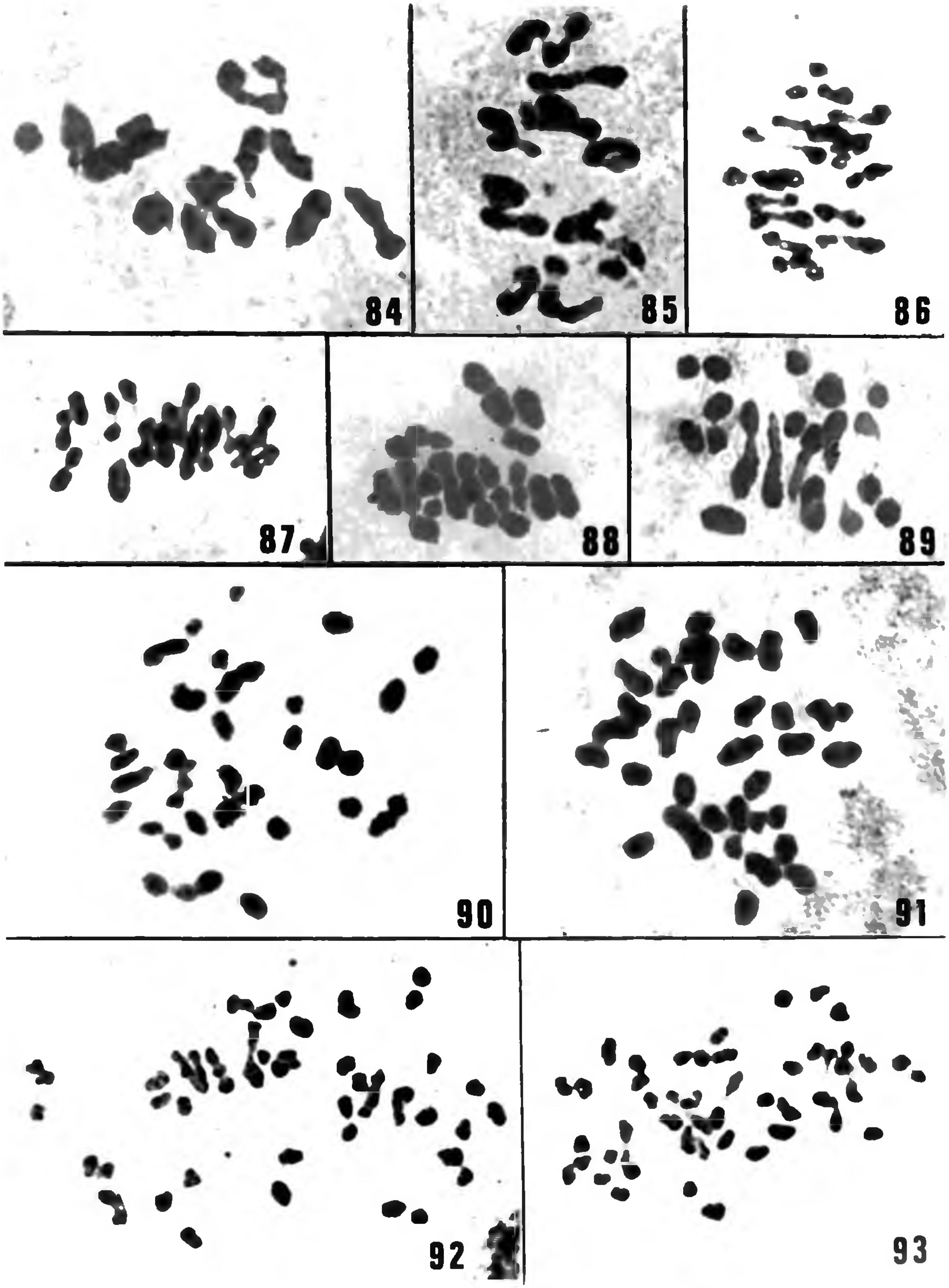
The homoploid F_1 hybrids with 2n = 30 were all fertile and the F_2 seedlings were vigorous (Table XIV).

The chromosome pairings in the intersectional Miltoniastrum x Teretifolia hybrids indicated a markedly strong homology of the parental genomes. The number of bivalents per PMC varied from 18 to 15 and the univalents from 0 to 6 for O. microchilum x O. nudum (both 2n = 36) (Fig. 88). A very high mean number of bivalents, 17.95 out of the possible 18, was observed in O. splendidum x O. nudum (also both 2n = 36)

Plate XXVIII. Metaphase I Configurations of *Oncidium* and *Trichonidium* primary hybrids (2,200X)

Figure:

84. *O. luridum* x *O. lanceanum*, 1 III + 12 II + 1 I
85. *O. splendidum* x *O. lanceanum*, 13 II + 5 I
86. *O. luridum* x *O. cebolleta*, 15 II + 3 I
87. *O. splendidum* x *O. nudum*, 18 II
88. *O. microchilum* x *O. nudum*, 18 II
89. *T. albo-purpureum* x *O. lanceanum*, 9 II + 7 I
90. *O. ampliatum* x *O. luridum*, 3 II + 31 I
91. *O. ampliatum* x *O. stramineum*, 1 II + 35 I
92. *O. triquetrum* x *O. floridanum*, 13 II + 23 I
93. *O. pulvinatum* x *O. floridanum*, 6 II + 37 I


84
85
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93

(Fig. 87). The hybrids between the 30 chromosome species of Miltoniastrum and the 36 chromosome species of Teretifolia appear to have all the chromosomes from the low parents paired with their counterparts from the high parents, and the extra chromosomes of the high parents unpaired or involved in multivalents association (Tables XII, Fig. 86). In both types of hybrids the sporad formations were irregular. Tetrads with or without microcytes as well as sporads with abberent number of cells with or without microcytes were seen (Table XIII, Fig. 100). All F_1 hybrids in this intersectional combination exhibited high sterility (Table XIV).

The intersectional Miltoniastrum x Pulvinata had irregular meiosis. Although an average of 13.2 out of the possible 18 bivalents per PMC were encountered in O. pulvinata x O. microchilum, the bivalents were highly heteromorphic (Table XII, Fig. 95). The products of meiosis were predominately irregular. (Table XIII).

Oncidium sect. Miltoniastrum x Trichocentrum exhibited irregular meiosis. The average bivalents per PMC was 7.8 out of the possible 12 bivalents when taking into account the availability of only 12 chromosomes from the low number parent in the hybrid (Table XII, Fig. 89). Most of the bivalents were highly heteromorphic. The products of meiosis were predominately tetrads. Aberrant sporads were also seen at a low frequency (Table XII).

The meiotic behavior and sporad formation of the hybrids between O. ampliatum and two species in the section Miltoniastrum were irregular, in spite of the striking resemblance in their vegetative morphology.

Altissima x Stellata and Stellata x Odontoglossum stenoglossum, both with 2n = 56, exhibited normal meiosis with uniformly 28 bivalents

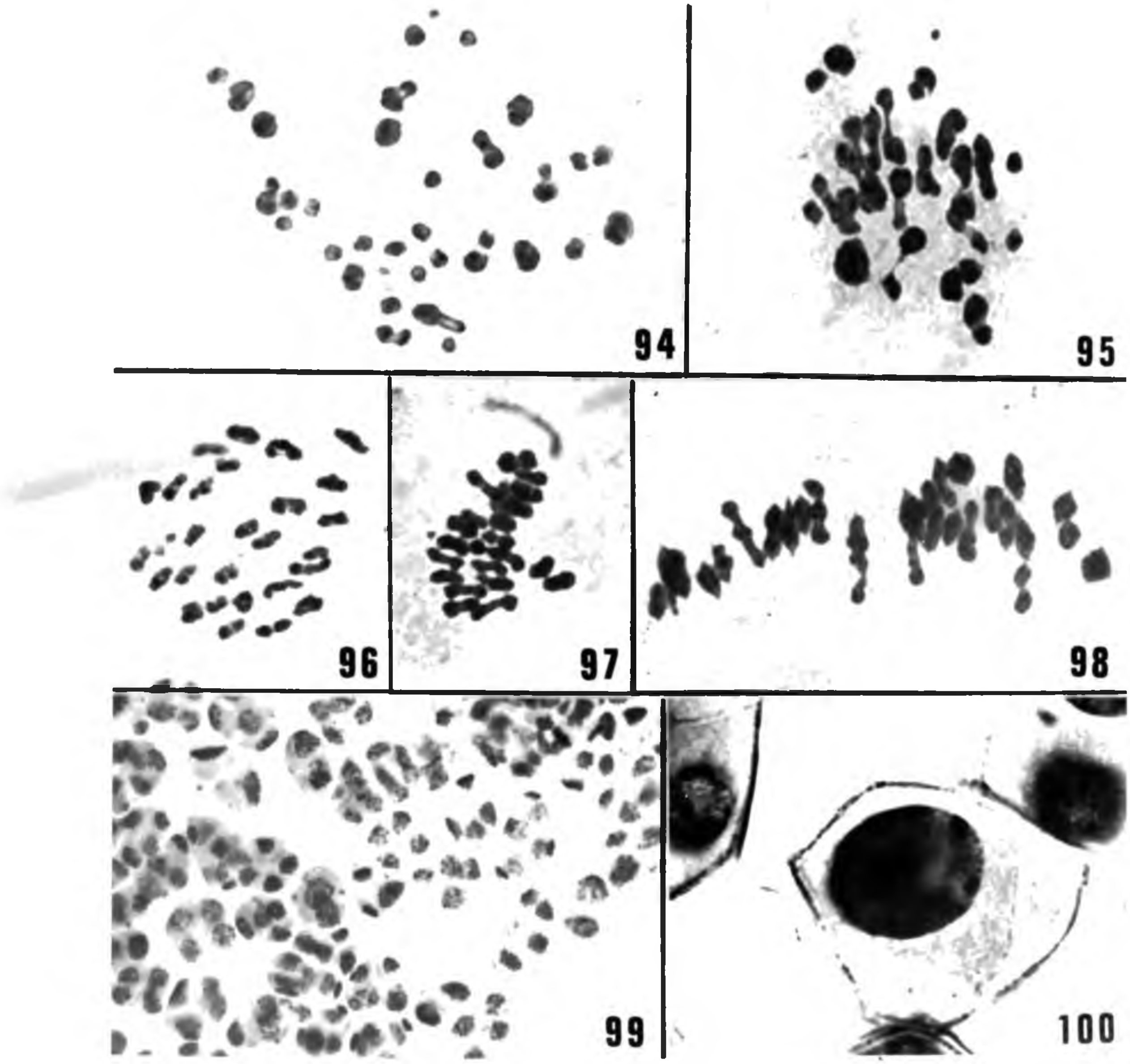
Plate XXIX A. Metaphase I configurations of _Oncidium_ and _Odontocidium_ primary hybrids (1,569X)

Figure:

94. _Oncidium microchilum_ x _O. floridanum_, 14 II + 18 I
95. _O. pulvinatum_ x _O. microchilum_, 14 II + 11 I
96. _O. floridanum_ x _O. maculatum_, 28 II
97. _O. altissimum_ x _O. sarcodes_, 28 II
98. _Odontoglossum stenoglossum_ x _Oncidium maculatum_, 28 II

Plate XXIX B. Sporad groups of primary _Oncidium_ hybrids

99. _O. triquetrum_ x _O. floridanum_ showing tetrads, tetrads + microcytes, dyads and dyads + microcytes (428X)
100. _O. microchilum_ x _O. nudum_, monad (1,569X)


94
95
96
97
98
99
100

per PMC, while Altissima x Crispa, also with 2n = 56, showed predominately 28 bivalents Table XII, Figs. 96-98). The sporads of those hybrids were uniformly tetrads (Table XIII). The F_1 plants of O. floridanum x O. maculatum in the Altissima x Stellata were fertile (Table XIV).

The hybrids of Equitantia x Altissima, Miltoniastrum x Altissima, and Pulvinata x Altissima exhibited poor to fair chromosome homology (Table XII, Figs. 92, 94). Most of the bivalents found in the PMCs of these hybrids were highly heteromorphic. The sporad formations showed various degrees of irregularity (Table XIV, Fig. 99).

Morphology of Species and Hybrids

The species hybrids exhibited plant and floral characters which are generally intermediate between the two parental species. Through hybridization between species, intermediate forms of several organs have emerged, linking the gap between extreme forms present in the natural species. The comparison of parental and hybrid forms of several vegetative and floral structures believed to be taxonomically important in the *Oncidium* alliance are given in Table XV.

Conspicuous vs. inconspicuous pseudobulb-- Several inconspicuous forms of pseudobulb appear to be either completely dominant or incompletely dominant to the conspicuous form (Table XV, Figs. 16 and 19). *Oncidium* section *Equitantia*, described as pseudobulbless by several authors, have consistently minute pseudobulbs hidden between the distichous basal leaves. Thus their pseudobulbs should be classified as inconspicuous instead of absent.

Leafy pseudobulb vs. leafless pseudobulb-- *Oncidium* hybrids between species with leafless pseudobulbs in *Oncidium* section *Equitantia* and species in other groups with leafy pseudobulbs have uniformly leafy pseudobulbs, uniformly leafless pseudobulbs, or both leafy pseudobulbs and leafless pseudobulbs in the same progeny (Table XV, Fig. 16). Some hybrid plants had leafy pseudobulbs in the seedling stage and leafless pseudobulbs in the mature plants.

Thick leathery terminal leaf vs. thin leathery terminal leaf-- The hybrids between these two forms usually have intermediate leaf thickness between the two parents (Table XV, Fig. 18).

TABLE XV. THE MORPHOLOGY OF PARENTAL SPECIES AND THE RESULTED HYBRIDS IN THE ONCIDIUM ALLIANCE.

Characteristic of the Parents	Characteristic of the Hybrid
Conspicuous Pseudobulb x Inconspicuous Pseudobulb	
Oncidium microchilum x O. luridum	inconspicuous psb.[1/]
O. microchilum x O. carthagenense	inconspicuous psb.
O. microchilum x O. lanceanum	inconspicuous psb.
O. microchilum x O. nudum	inconspicuous psb.
O. splendidum x O. lanceanum	inconspicuous psb.
O. splendidum x O. nudum	inconspicuous psb.
O. ampliatum x O. nudum	inconspicuous psb.
O. ampliatum x O. luridum	inconspicuous psb.
Inconspicuous Pseudobulb x Conspicuous Pseudobulb	
O. triquetrum x O. cebolleta	inconspicuous psb.
O. triquetrum x O. floridanum	inconspicuous psb.
O. triquetrum x O. onustum	intermediate between the two parents
O. triquetrum x O. splendidum	inconspicuous psb.
O. triquetrum x O. flexuosum	intermediate between the two parents
O. triquetrum x Comparettia falcata	inconspicuous psb.
O. pulchellum x O. flexuosum	intermediate between the two parents
O. carthagenense x O. splendidum	inconspicuous psb.
Leafless Pseudobulb x Leafy Pseudobulb	
O. triquetrum x O. floridanum	leafy psb., leafless psb., and leafy psb. in seedlings and leafless psb. in mature plants
O. triquetrum x O. flexuosum	uniformly leafy psb. in seedlings
O. triquetrum x O. cebolleta	uniformly leafy psb. in seedlings
O. triquetrum x O. splendidum	uniformly leafless psb.
O. triquetrum x Comparettia falcata	uniformly leafless psb.
O. pulchellum x O. flexuosum	uniformly leafy psb. in seedlings

1/ psb. is abbreviation for pseudobulb

TABLE XV. (Continued) THE MORPHOLOGY OF PARENTAL SPECIES AND THE RESULTED HYBRIDS IN THE ONCIDIUM ALLIANCE.

Characteristic of the Parents	Characteristic of the Hybrid
Thick Terminal Leaf x Thin Terminal Leaf	
O. microchilum x O. onustum	intermediate thickness between the two parents
O. microchilum x O. floridanum	intermediate thickness between the two parents
O. pulvinatum x O. floridanum	intermediate thickness between the two parents
Flat Terminal Leaf x Terete Terminal Leaf	
O. luridum x O. cebolleta	semi-terete leaf
O. luridum x O. nudum	semi-terete leaf
O. luridum x O. stipitatum	semi-terete leaf
O. microchilum x O. nudum	semi-terete leaf
O. microchilum x O. cebolleta (4N)	semi-terete leaf
O. ampliatum x O. nudum	semi-terete leaf
Terete Terminal Leaf x Flat Terminal Leaf	
O. nudum x O. cebolleta	semi-terete leaf
O. nudum x O. ampliatum	semi-terete leaf
O. nudum x O. ansiferum	semi-terete leaf
Three-edged Distichous Leaves x Flat Distichous Leaves	
O. triquetrum x O. floridanum	flat distichous leaves
O. triquetrum x O. flexuosum	flat distichous leaves
O. pulchellum x O. flexuosum	flat distichous leaves
No Distichous Leaf x Numerous Distichous Leaves	
O. microchilum x O. floridanum	few distichous leaves
O. pulvinatum x O. floridanum	few distichous leaves
Numerous Distichous Leaves x No Distichous Leaf	
O. altissimum x O. sarcodes	few distichous leaves
O. triquetrum x O. cebolleta	few distichous leaves
O. triquetrum x O. splendidum	few distichous leaves
O. pulvinatum x O. stipitatum	few distichous leaves

TABLE XV. (Continued) THE MORPHOLOGY OF PARENTAL SPECIES AND THE RESULTED HYBRIDS IN THE *ONCIDIUM* ALLIANCE.

Characteristic of the Parents	Characteristic of the Hybrid
No Distichous Leaf x Few Distichous Leaves	
O. microchilum x *O. onustum*	no distichous leaf
Comparettia falcata x *O. onustum*	few distichous leaves
Lip without a Callus x Lip with a Callus	
O. triquetrum x *O. lucayanum*	lip with a callus
O. triquetrum x *O. desertorum*	lip with a callus
O. triquetrum x *O. variegatum*	lip with a callus
O. triquetrum x *O. floridanum*	lip with a callus
Lip with a Callus x Lip without a Callus	
O. pulchellum x *O. triquetrum*	lip with a callus
Midlobe of the Lip, Missing x Midlobe of the Lip, Present	
O. microbhilum x *O. nudum*	midlobe of the lip, present
O. microchilum x *O. luridum*	midlobe of the lip, present
O. microchilum x *O. carthagenense*	midlobe of the lip, present
O. microchilum x *O. floridanum*	midlobe of the lip, present
Midlobe of the Lip, Present x Midlobe of the Lip, Missing	
O. pulvinatum x *O. microchilum*	midlobe of the lip, present
Flower with a Spur x Flower without a Spur	
Trichocentrum albo-purpureum x *O. lanceanum*	flower without a spur
Comparettia falcata x *O. onustum*	flower without a spur
Fused Lateral Sepals x Free Lateral Sepals	
O. triquetrum x *O. floridanum*	fused lateral sepals
O. triquetrum x *O. onustum*	fused lateral sepals
Comparettia falcata x *O. onustum*	fused lateral sepals

TABLE XV. (Continued) THE MORPHOLOGY OF PARENTAL SPECIES AND THE RESULTED HYBRIDS IN THE ONCIDIUM ALLIANCE.

Characteristic of the Parents	Characteristic of the Hybrid
Free Lateral Sepals x Fused Lateral Sepals	
O. maculatum x *Rodriguezia venusta*	fused lateral sepals

Flat terminal leaf vs. terete terminal leaf-- Terete leaves, are considered more advanced character in most orchids (Dressler and Dodson, 1960). The hybrids between flat leaved species and those with terete leaves have semiterete leaves, intermediate between the two parents (Table XV, Fig. 19).

Flat distichous leaf vs. three-edged distichous leaf-- The flat distichous leaf character appears to be dominant to the three-edged leaf (Table XV).

Numerous distichous leaves vs. no distichous leaves-- Species in the sections Miltoniastrum, Teretifolia, Pulvinata and Crispa of the genus Oncidium, O. ampliatum, and Comparettia falcata have distichous leaves subtending the base of the first pseudobulb grown from seeds. When the plant becomes mature its distichous leaves are usually reduced into membraneous bracts by lose the leaf blade and retaining only the leaf sheath which dries up shortly after the new pseudobulb is fully developed. The hybrid between the species with numerous distichous leaves and those without distichous leaves usually have few distichous leaves (Table XV, Fig. 18).

Few distichous leaves vs. no distichous leaves-- Different crosses between species with few distichous leaves and those without distichous leaves have either uniformly no distichous leaf or uniformly few distichous leaves (Table XV, Fig. 17).

Lip with a callus vs. lip without a callus-- O. triquetrum, the only species in the Oncidium genus that has no callus, produced hybrids which have callus on their lip.

Lip with a midlobe vs. lip without a midlobe-- O. microchilum often mistaken for a member of the section Cyrtochilum because it has a small lip without an obvious midlobe of the lip produced hybrids with well developed midlobe of the lip when crossed with species having midlobe of the lip (Fig. 13). The absence of the lip midlobe in the species might represent only a single or few mutations in the loci of the genes controlling the development of the lip midlobe.

Spurred flower vs. not spurred flower-- One species each with spurred flowers in the genus Trichocentrum and Comparettia when crossed with spurless Oncidium species produced spurless hybrids (Table XV).

Free lateral sepals vs. fused lateral sepals-- Species of Oncidium sect. Equitantia, Rodriguezia and Comparettia have fused lateral sepals. The F_1 hybrids between these species and those with free lateral sepals have uniformly fused sepals (Fig. 14).

General Discussion

Darwin (1897) discussed self-incompatibility in *Oncidium flexuosum* and *O. microchilum*, and even today the system of self-incompatibility in the *Oncidium* alliance still remains unknown. Since self-compatible plants are relatively uncommon and are found in several distinct groups, it is logical to assume that self-compatible forms might have arisen independently in different lines of the alliance. Thus the distinction regarding self-compatibility and self-incompatibility might not be significant in phylogeny.

Wilfret and Kamemoto (1969) in their study on the genus *Dendrobium* stated that: "Although failure in producing successful crosses at intra- and intersectional levels may not always indicate the degree of relationship of species, the relative success in obtaining interspecific hybrids is a good indicator of relationship." In the *Oncidium* alliance, the results obtained from the present investigation indicate that crosses between remotely related species may be relatively highly successful. For example, *O. pulvinatum* (2n = 42) x *O. floridanum* (2n = 56) gave 100% fruit set and 96.5% viable seed, inspite of the difference in external morphology and chromosome numbers in the parental species, and the poor homology of the parental species genomes. Members of the *Oncidium* alliance probably have been evolving rapidly in chromosome number and external morphology. Although the species are reproductively isolated by either ethological, mechanical, or geographical factors, the genomes may still be compatible and capable of producing vigorous F_1 hybrids when crosses are artificially made under greenhouse condition. Also the species utilized are of polyploidal number and, therefore the hybrids with duplicates of certain chromosome segments contributed by each parent might be chromosomally balanced and have better survival than the hybrids at lower chromosome number levels. Thus crossability *per se* may serve as a good indicator of relationships, but the degree of phylogenetic relationship may or may not be correlated with the degree of crossability and seed viability. Therefore, phylogenetic relationships on the basis of ease of crossability should be used with caution and in conjunction with external morphology, chromosome numbers, genome homology and other available characters.

Variations in chromosome numbers of species in the *Oncidium* alliance can be attributed to polyploidy, aneuploidy and hybridization. Sinoto (1962) proposed both n = 5 and 7 as basic haploid numbers based on 2n = 10 for *O. pusillum* and 2n = 14 for *O. glossomystax*. Dodson (1958) suggested n = 7 as the basic number, and n = 5 as the results of stepwise reduction of chromosome number from n = 7. Dodson and Dressler (1972) proposed that both n = 5 and 7 may represent reductions from a higher basic number. The basic number of 7 can explain the occurrence of the majority of species in the *Oncidium* alliance which form the euploid series of 2n = 14 (2X), 28 (4X), 42 (6X), 56 (8X), 84 (12X) and 126 (18X).

The numbers 2n = 24, 26 and 30 in the section *Miltoniastrum* and *Teretifolia* of *Oncidium*, and the genus *Trichocentrum* can conceivably have resulted through reduction and increase from the number 2n = 28. According to Dodson (1958) the numbers 2n = 36 and 38 might be fixed aneuploid derivatives as results of crossing between 2n = 28 and 2n = 42.

The chromosome number 2n = 40 in *Oncidium* sect. *Equitantia* might be the reduction from 2n = 42. The number 2n = 44 can have resulted through the increase from the number 2n = 42.

Based on the morphological diversity of the species in the Oncidium alliance, it would appear that the different species with the same high chromosome numbers: 42, 44, 56 and 60 might be polyploids which arose independently from different low chromosome number ancestors.

Stebbins (1950) claims that asymmetrical karyotypes in plants are usually correlated with specializations in external morphology. In the present study there is no apparent relationship between the asymmetry of karyotype morphology and the evolution of external morphology.

Chromosome numbers of 2n = 40, 42, 84 and 126 were observed in the section Equitantia. Hybrids involving 42 chromosome parents as well as those with 42 and 40 chromosome parents exhibited complete or almost complete homology of parental genomes indicating a close relationship of both groups. Oncidium calochilum, a species often classifed in the section Teretifolia because it has two distichous terete leaves that resemble terminal terete leaves (Kranzlin, 1922; Garay, 1970), has 2n = 42, and high cross compatibility with other species in the Equitantia section. All evidences obtained from this investigation clearly indicate that O. calochilum belongs to the section Equitantia as proposed by Moir and Moir (1970). The species in the Equitantia generally appear to have low crossability with other groups of Oncidium. The cross between O. triquetrum (2n = 42) in the section Equitantia and O. floridanum (2n = 56) in the section Altissima exhibited 13.2 bivalents per PMC indicating a fair degree of homology. The two sections, Equitantia and Altissima, may, therefore be considered distinct and divergent both cytologically and morphologically. Rodriguezia venusta was crossed to O. triquetrum with ease (Table VIII). They both have 2n = 42, lateral sepals in a synsepalum, and strong resemblance in growth habit. Further investigation on meiosis of the hybrid Oncidium sect. Equitantia x Rodriguezia should provide additional information on their relationship.

The species in the section Teretifolia with 2n = 36 and 72 including O. cebolleta, O. nudum and O. stipitatum differ from one another in minute details of the floral characters. O. cebolleta has a wide distribution from Mexico, Central America, West Indies, Venezuela to Paraguay (Foldats, 1970). Oncidium stipitatum is found in Panama (Lindley, 1955) while O. nudum is a native of Panama, Colombia and Venezuela (Foldats, 1970). Numerous proposed species have been made synonymous or reduced to varieties or forms of O. cebolleta (Lindley, 1955; Garay, 1970). On the basis of geographical distribution, strong resemblance in morphology, extremely high crossability, complete chromosome pairing and full fertility of the F_1 hybrids among the 36 chromosome forms of the three species, O. nudum and O. stipitatum might be considered varieties or geographical races differing from the regular O. cebolleta in a few floral characters. Oncidium jonesianum is very similar to the above three species in growth habit and plant morphology; however its chromosome number is 2n = 30.

On the basis of external morphology, ease of crossability, chromosome number, morphology and homology, and fertility of the hybrids, O. carthagenense, O. luridum and O. stramineum are very closely related. O. luridum and O. carthagenense have wide distribution from Florida, Mexico, through central America and all three species occur in Vera Cruz, Mexico (Lindley, 1955). A number of varieties of O. luridum are believed to be interspecific hybrids between O. luridum and O. carthagenense

(Teuscher, 1972; Moir, 1972). The flowers of _O. carthagenense_ x _O. luridum_ obtained in this investigation resemble _O. luridum_ in most characters except its intermediate flower colour. Thus, Teuscher's suggestion on the hybrid origin of those varieties of _O. luridum_ such as var. _morrenii_ has merit. If chance interspecific crossing between _O. luridum_ and _O. carthagenense_ occurs at a low rate, the back crossing of the F_1 to either parental species might lead to exchange of genes between the two species, since the F_1 hybrid is fully fertile or nearly so.

Although the species in the _Miltoniastrum_ section of the genus _Oncidium_ exhibited diverse chromosome numbers, the crossability of species within the section is relatively high and the species hybrids exhibited very high homology of the species genomes.

The intersectional _Miltoniastrum_ x _Teretifolia_ hybrids exhibited as strong homology of species genomes as those of the intrasectional _Miltoniastrum_ hybrids. The overall results of the present investigation clearly indicate that the flat thick leaf vs. terete leaf character that separates the two groups does not appear to be a significant phylogenetic character. Both groups have similar variation of chromosome numbers, growth habit, high crossability between them, and nearly complete chromosome homology in their F_1 hybrids, Williams (1972) found that the morphology of the pollinarium in _O. splendidum_ (Miltoniastrum) and _Teretifolia_ is alike. Perhaps the two sections should be merged.

O. pulvinatum in the section _Pulvinata_ of _Oncidium_ is highly cross-compatible to a wide range of species. The hybrid _O. pulvinatum_ (2n = 42) x _O. microchilum_ (2n = 36, section _Miltoniastrum_) formed 13.2 bivalents indicating fair homology, while _O. pulvinatum_ (2n = 42) x _O. floridanum_

(2n = 56 section Altissima) formed an average of only 6.8 bivalents. On the basis of chromosome homology, the section Pulvinata is more closely related to the section Miltoniastrum than to the section Altissima. The growth habit of the section Pulvinata is also closer to the section Miltoniastrum. Thus the section Pulvinata appears to be a distinct group.

O. ampliatum was assigned to the section Oblongata by Kranzlin (1922) and the section Miltoniastrum by Moir (1972). Dodson (1958) listed O. ampliatum as closely related to O. papilio, the type of the section Glanduligera. Williams (1972), on the other hand, described to O. ampliatum as "anomalous in almost all of its features" and although the pollinarium is similar to that of the Miltoniastrum group cannot be classified into any group. The results of the present investigation are generally in agreement with Williams' view. Oncidium ampliatum was successfully crossed to a wide range of species in several sections of Oncidium and a few species in related genera although with great difficulty (Tables, VII and VIII). The hybrids between O. ampliatum and both O. luridum and O. stramineum exhibited poor homology of parental genomes. On the basis of morphology, crossability and chromosome homology, O. ampliatum appears to be distinctly different from species in the Miltoniastrum section. Therefore, it might be placed into a new section.

O. floridanum x O. maculatum (Section Altissima x Section Stellata) exhibited complete homology of the parental species, and the species in both sections were crossed with ease, Although intersectional crosses attempted in the present investigation between species in the sections Altissima and Crispa failed, the almost complete homology of parental genomes was observed in a previously available hybrid O. altissimum x O. sarcodes. It is of interest to note that Odontoglossum stenoglossum was crossed with Oncidium maculatum in the section Stellata with ease and the hybrid exhibited complete homology of the parental genomes. Dodson (1958) proposed that the 56-chromosome species in the genus Oncidium, Odontoglossum, etc. be removed to a new genus or genera. Garay (1963) pointed out that Oncidium differs from Odontoglossum solely in the angle between lip and column. Therefore it seems logical to unite Odontoglossum stenoglossum with the sections Altissima, Stellata and Crispa of Oncidium.

Although the growth habit and the pattern of variation in chromosome numbers of the genus Trichocentrum and the section Miltoniastrum of Oncidium are very similar, Trichocentrum and Oncidium sect. Miltoniastrum are different in that the latter has spurless flowers and also the meiotic behavior in the hybrid, T. albo-purpureum (2n = 24) x O. lanceanum (2n = 26) is irregular. Trichocentrum with its miniature plant size and spurred flowers can be considered a distinct group that might have evolved from Oncidium sect. Miltoniastrum.

SUMMARY

Investigations of intraspecific self- and cross-pollinations, cross-compatibility, chromosome number determinations, and karyotype analysis were made with species of the Oncidium alliance. Observations on chromosome numbers, genome relationships, sporad group formation and fertility of species hybrids were made. Vegetative and floral characteristics of species hybrids were compared with those of their parents.

A self- and cross-pollination study was made utilizing 38 species in 5 genera. Twenty-five species were found to be self-incompatible, 11 were self-compatible, and 2 were variable. Self-incompatibility appears to be a common phenomenon in the alliance.

Interspecific, intersectional and intergeneric hybridization studies were made utilizing 3 Brassia supp., 1 Comparettia sp., 1 Gomesa sp., 2 Miltonia spp., 4 Odontoglossum spp., 39 Oncidium spp., and 1 Rodriguezia sp. Species crossed as readily within a section as between sections, and as readily within a genus as between genera, providing additional evidence on the degree of relationships among the members of the Oncidium alliance.

The chromosome numbers of 53 species and natural hybrids representing 13 genera of the Oncidium alliance were determined. Seventenn of these have never been reported before: Ada elegentula (2n = 60), Aspasia epidendroides (2n = 60), Lockhartia micrantha (2n = 56), Oncidium micropogon (2n = 56), O. x ann-hadderiae (2n = 42), O. calochilum (2n = 42), O. x cubense (2n = 42), O. x floride-phillepsiae (2n = 126), O. jimenezii (2n = 42), O. lemonianum (2n = 42), O. quadrilobum (2n -40), O. x varvelum (2n = 63), O. velutinum (2n = 84), O. limingnei (2n = 56), Ornithophora radicans (2n = 56), Trichocentrum capistratum (2n = 28), and Trichopilia marginata (2n = 56).

In the genus *Oncidium*, species in the *Miltoniastrum* section had 2n = 26, 28, 30, and 36. The chromosome numbers 2n = 30, 36, and 72 were observed for species in the section *Teretifolia*. The section Equitantia showed 2n = 40, 42, 84 and 126 with the exception of a triploid natural hybrid, *O. x varvelum* with 2n = 63. The section *Pulvinata* and *O. ampliatum* exhibited 2n = 42 and 44 respectively. The section *Glanduligera* was represented by 2n = 38 and 56. The sections *Altissima*, *Barbata*, *Crispa*, *Oblongata*, *Serpentia*, and *Synsepala* of *Oncidium*, and species of *Gomesa*, *Ornithophora*, *Lockhartia*, *Trichopilia* and *Miltonia* sect Miltoniopsis had 2n = 56. The chromosome numbers 2n = 24 and 28 were observed for species of *Trichocentrum*. The chromosome number 2n = 60 was encountered among species of *Ada*, *Aspasia*, *Brassia* section *Brassia* and *Miltonia* sect *Eumiltonia*.

Chromosome numbers of 80 hybrid plants which resulted from hybridizations between plants with known chromosome numbers were usually the sum of the normally reduced gametic numbers of the two parents. One plant resulted from a union between a reduced egg and an unreduced pollen while two others resulted from spontaneous chromosome doubling of hybrids with regular chromosome numbers.

Analysis of karyotypes was made for 10 *Oncidium* species and 1 *Trichocentrum* sp. Oncidium spp. in the section *Miltoniastrum* can be distinguished by their distinct satellite chromosomes. *Oncidium ampliatum* and *O. papilio* can be distinguished by their symmetrical karyotypes.

Meiosis and sporad formation were analyzed in 31 *Odontocidium*, *Oncidium* and *Trichonidium* primary hybrids. Relatively good to complete homology of the parental genomes was found in the intrasectional hybrids in Oncidium sections Equitantia, Teretifolia and Miltoniastrum, the intersectional Miltoniastrum x Teretifolia, Altissima x Stellata, and Altissima x Crispa hybrids and the intergeneric hybrid Odontoglossum stenoglossum x Oncidium maculatum (Stellata). Fair to low chromosome homology of the parental genome was found in intersectional Oncidium Miltoniastrum x Pulvinata, Altissima x Miltoniastrum, Altissima x Pulvinata, Altissima x Equitantia, and Miltoniastrum x O. ampliatum hybrids, and in the intergeneric Oncidium sect. Miltoniastrum x Trichocentrum hybrids.

The homoploid intrasectional hybrids in Equitantia, Miltoniastrum, and Teretifolia were highly fertile. The Miltoniastrum x Teretifolia hybrids exhibited very low fertility.

The overall vegetative and floral morphology of species hybrids were generally intermediate between the parental species.

Genome relationships indicated that the sections Equitantia and Pulvinata of the genus Oncidium and the genus Trichocentrum are distinct groups. The sections Miltoniastrum and Teretifolia of Oncidium might be merged. The sections Crispa, Stellata, and Altissima of Oncidium and Odontoglossum stenoglossum appear to form a natural grouping and might be united.

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